FARU 2020
CONFERENCE PROCEEDINGS

13TH INTERNATIONAL RESEARCH CONFERENCE Virtual Conference

DIMENSIONS OF SPACE
Multi-disciplinary Approaches

6 – 9 NOVEMBER 2020

ORGANIZED BY

FARU FACULTY OF ARCHITECTURE RESEARCH UNIT
UNIVERSITY OF MORATUWA, SRI LANKA

Double blind reviewed and accepted research papers of the conference are included in this volume

About FARU

FARU is the Research Unit of the Faculty of Architecture, University of Moratuwa, Sri Lanka and its is built on the four academic Departments of the Faculty of Architecture; Dept. of Architecture, Dept. Building Economics, Dept. Town and Country Planning and Dept. Integrated Design. Thus, FARU provides a space to discuss and exchang viewpoints among researchers, professionals, academics and industry experts within allied fields of study.

Due to the outbreak of Covid-19, FARU 2020 is conducted as a virtual Conference from the 6th to 9th November 2020 and will mark the 13th International Research Conference.

The FARU organizing committee acknowledge the support extended by the University of Moratuwa and all sponsors.

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Contents

Poster Abstracts

Editor's Note

Faculty of Architecture Research Unit (FARU) of University of Moratuwa, Sri Lanka is organizing the 13th FARU International Research Conference focused on Dimensions of Space. It is scheduled to be held as a virtual conference, hosted from Sri Lanka on the 06th – 09th November 2020. The conference will provide a forum for researchers, academics, practitioners and students in the areas of Architecture, Built Environment, Town and Country Planning, Building Economics, Facilities Management and Design.

The theme of FARU 2020 discuss research on 'space' and different dimensions of it within the discipline of Build Environment, Town and Country Planning, Building Economics and Design. Here, Space is interpreted as an element of design in architecture, design and the build environment, or as agglomeration of urban elements, open spaces in town and country planning. Space also is defined as the professional space within the construction industry and the contribution towards building economics and quantity surveying. Be it a physical or a virtual space the discipline of design also revolves around it. Keeping this in mind FARU 2020 opens up the platform to discourse theoretical or empirical case studies through discussions, debate across disciplines under the following sessions:

Session #01 - Urban Movements
Session #02 - Social Interactions and Community Resilience
Session #03 - Sustainable Practices
Session #04 - Facilities Management
Session #05 - Construction and Building materials
Session #06 - Smart Growth and Technology
Session #07 - Social Responsibility and Professional Practices
Session #08 - Human Resource and Management
Session #09 - Vernacular Practices
Session #10 - Construction Industry Practices

I wish to congratulate all the authors for their contribution, for sharing their insights towards exchange of ideas, information and knowledge.

Looking forward for a successful conference.

Dr. Sumanthri Samarawickrama
Director, Faculty of Architecture Research Unit
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Message from the Dean, Faculty of Architecture

It is an honour and pleasure to welcome all of you to '13th FARU Research Conference' of Faculty of Architecture, University of Moratuwa, Sri Lanka. Research is an integral and important activity of the academic institutes, contributing to expand the boundaries of existing knowledge. The research culture of the Faculty of Architecture, University of Moratuwa has been growing over the years and has acquired national and international level recognition.

The research of the Faculty focuses attention on subject areas of Architecture, Building Sciences, Environmental Design, Building Economics, Facilities Management, Planning, Landscape Architecture, Design and Project Management. The University and the Faculty encourage the conduct of research and the dissemination of new knowledge. The University provides funding mainly through SRC (Senate Research Committee) grants and facilitates the collaborations with external organizations.

The theme of this year's symposium is 'DIMENSIONS OF SPACE - Multi-disciplinary Approaches'. It is discussed under six tracks; Disaster Management & Climate Change, Construction Property & Management, Smart Growth & Sustainability, Built form & Design across Cultures, Vernacular Practices & Conservation and Design Education & Pedagogy.

The annual FARU conference has developed as an important meeting point for both local and global researchers over the years. The exchange of ideas and interactions are of vital significance for the development of the research culture. FARU has become a strong platform for such activities and a much anticipated annual event by the academic community.

Due to the COVID 19 and connected health concerns, the conference of this year is conducted through online mode. As a consequence, the important activities of the face to face meetings and social networking will be missed. Nevertheless it will facilitate the opportunity for the research community to disseminate and share their knowledge with the peers.

FARU 2020, the 13th research conference intends to open up a forum for a wider range of research and scholarly works on the latest advancements of all disciplines related to built environment and design. The participation of high caliber local and international research scholars and practitioners would enhance the quality of presentations and intellectual discussions of the conference.

I wish 'FARU Research Conference 2020' all success.

Dr. D.P.Chandrasekara
Dean, Faculty of Architecture
University of Moratuwa
Sri Lanka

Keynote Address

GAZING FOR A COGNITION-BASED CURRICULUM IN ARCHITECTURE EDUCATION

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Abstract
Architectural education is at crossroads facing the challenges of the global nature including that of the increasing influence of computers, changing roles of professionals due to globalization, perils of climate change, falling economy, pandemics, and man-induced calamities. The shortfall intoday's education is that it does not prepare the professionals of tomorrow who are employable and empowered to care for such perils. In order to empower the professionals to deal with this changing scenario; *with its vastitude,* it is important to look at the architectural curriculum in general and the design of subjects in particular. Although many types of research have been conducted in 'how adults learn and how instruction can be designed to facilitate learning and maximize performance', too little of the cutting-edge knowledge in the field has been made its way into architectural education. The majority of programs, especially those delivered in classrooms are through traditional lecturesand continue to be designed by subject matter experts 'who rely on their own intuition and experience', rather than a 'systematically applied theory of instructional design'. Studies conducted with stakeholders particularly students of the B. Arch programme reveal that over and above the systems model, it is high time to look into the mode of delivery and its structure to enhance the *'cognition-based learning and empowerment'* of the learners. This paper deals with the evolution of architectural education over the globe and particularly in post-independent India. Further, the advantages and importance to design the design curricula in terms of *cognition-based learning* are put forth.

Keywords: Cognitive Learning, Creative thinking, Empowerment, Symbolic tools

INTRODUCTION

Architectural education is at crossroads facing the challenges of the global nature including that of the increasing influence of computers, changing roles of professionals due to globalization, perils of climate change, pandemics, falling economy, and man-induced calamities. The very reason why architects look aghast at all these situations is education today does not prepare the professionals of tomorrow who are 'employable and enabled to take care of' such perils. In order to prepare and enable professionals to deal with this changing scenario*; with its vastitude,* it is important to look at the architectural curriculum in general and the design of subjects in particular. Although many types of research have been conducted in 'how adults learn and how instruction can be designed to facilitate learning and maximize performance', too little of the cutting-edge knowledge in the field has been made its way into the daily practice of training. The majority of programs, especially those delivered in classrooms through the traditional lecture of continue to be designed by subject matter experts who rely on their own intuition and experience to guide them, rather than a *systematically applied theory of instructional design*(Ford J). A growing number of training programs, especially those designed for delivery via the Internet, computer, or other electronic media, are developed using a systems model of instruction so that the right content is taught to the right people at the right time. Over and above the *systems model*, it is high time to look into the mode of delivery and its structure to enhance the 'cognition-based learning and empowerment' of the learners. The learner empowerment is the result of a cognition-based pedagogy and to ensure this end result, much research is needed. In a fast-developing world, there is a limitation of time for the learning process. It must be noted that the current B. Arch curriculum has been shrunk effectively to four years as against the traditional five-year model prevailed in India (Jayakumar and George). This is one of the detrimental effects of institutionalization and industrialization of education as seen in Architecture. Whereas, it must be observed that design is to be induced into a learner taking time of its own and rat-race is not leading to effectiveness or empowerment. This sad fact is reflected in the employability of the products of such a system as seen in the stakeholder's response; *particularly of industry and professional firms*. It is of no wonder that the employers cannot invest in employee development, *but in production for their survival,* especially when the global economy is down. If not, the employer must be convinced of the fact that a well-trained, empowered graduate is inevitable for his business success. The bleak response of the stakeholders over a period of time has percolated disturbing message that 'they are not likely to

get the expected level of job or pay as compared to the normal graduates' of other fields, a great majority lose their interest and focus on other subjects and areas of fetching. This unhealthy trend is observed from the highest level of institutes to the lower level schools of architecture.The total number of colleges in India is around 465, and the year-wise enrollment is 22000.The percentage of vacancies kept on increasing per year, in 2008-09; 9% and in 2019-20, 36.25% (Council of Architecture). The number of vacant seats in various schools of architecture as against the predictions of the *Council of Architecture* and *Indian Institute of Architects* now presents a faint picture nationally requiring an alternate mode of delivery and cognition-based learning.

The hope of the times is the declaration of National Education Policy-2020 by the Ministry of Education, Govt. of India. This policy essentially restructures education at initial and higher education levels to a more practical, visionary outlook upholding the traditional values and knowledge systems. The policy lays stress on bi-lingual and student-centric educational processes which will make the learners to take cognition of what they learn and to be empowered after the successful completion of the programme. The highlights are collaborative research, design, and innovation, and learn how to learn in the process of education (India). It lays thrust on that education must develop not only cognitive capacities; *'foundational capacities'of literacy and numeracy and 'higher-order' cognitive capacities, such as critical thinking and problem solving,* but also social, ethical, and emotional capacities and dispositions for which social aspects and cultural aspects shall be integrated into learning processes. The tragic departure of architecture from mathematics, basic sciences, research with scientific rigor,and literature has made it a visual art more than performing architecture which will better human habitation and the total environment where it stands. In India, only IITs seem to lay stress on research in its true sense and integration of design with other branches of engineering, arts, and even the science of happiness. Mostly other schools still linger behind and produce works of visual nature. Perhaps that is what the outside market expects from the current generation, with much less pay! However, the truth always lies in performing architecture where visual quality is only one among many of the expectations; energy efficiency, resource management, rainwater harvesting, solar energy generation, besides accommodating human lives with happiness and comfort. Until and unless future generations are trained for *'learning how to learn'* and *'Do it yourself'* projects, with enabled faculty and sufficiently equipped laboratories, the products of architectural education will be stunted in real abilities, with low or no empowerment to deal with the real-life scenario. Therefore, it is high time to gaze for a cognition-based architectural curriculum and mode of delivery.

ARCHITECTURAL CURRICULUM AND ITS EVOLUTION

Architects are considered the 'key professionals in the construction industry', as in Europe, because of their wider knowledge, communication abilities, system understanding, and the ability to coordinate among various teammates in the process. These unique abilities make them specially trained to address the future and present design and developmental projects. In the United States of America, the legal definition of 'architect' appeared after 1897 when Illinois adopted a licensing law.However, the massive institutionalization; where profit rules even diluted the admission policy, quality infrastructure, and enabled faculty members. The greater number of schools emerged;the greater number of architects were produced. The system kept cool for so long a time until it began to kick back; less enabled architects and less and lesser pay package. This situation is worsened by the dwindling economy, material prices, non-availability of the skilled labour force, and many other reasons. By this time technological developments advanced and the cost of education too increased. However, the quality and empowerment of architects churned out of such a deteriorating system with its own politics and profit motivation led the situation to its current peril.

THE POST-INDEPENDENCE SCENARIO IN INDIA

Council of Architecture (CoA); is the statutory body that controls the profession, practice, and education in India. All India Council for Technical Education (AICTE) and Directorates of Technical

Education in respective states (DTE) play a major role in Architectural education within a certain statutory, regulatory and supervisory framework existing in the Country. Council of Architecture was formed as the regulatory body of the profession as well as architectural education after the Architects Act, 1972 was passed. The role of the All India Council of Technical Education role is to formulate and unify technical education policy level decisions within the Nation, in alignment with CoA. Directorate of Technical Education in respective states has authority over the overall conduct in alignment with the respective educational ministry. The status of DTE is assigned to Technical University (TU) in recent times. The Ministry of Human Resource Development (MHRD) at the central level and respective Department of Education in various states are the umbrellas which functionsare at the broad policy level. IIA on the contrary is a professional body registered under the societies' act and not a statutory body. It furthers the fraternity of architects all over the country and maintains a link between the professionals, industries, academics, and students alike. National Association of Students of Architecture (NASA) is an independent body with an agenda of students' activities; however, it does not have any direct say in the matters of education despite being the body of takers of architectural education!

Architectural education at Bachelor (UG) level; *if approved by the CoA,* entitles the holder with a Registration Number which is mandatory for the practice of the profession in India. Thus, the CoA has the full responsibility and power vested in it to prescribe, modify, and regulate architectural education in India. Each institute or school of architecture is assigned a CoA number and maintains close contact. Further, the process and method of instruction are under the close scrutiny of CoA through periodical expert visits and renewal of the approval process. Even then, it is sad to say that the matter and method of instruction prevailed without appropriate modification suiting to the changing world scenario. Syllabus revisions kept on happening in good Institutes and universities without paying much attention to the matter and mode of delivery; a much futile periodical exercise! However, each university or institute can prescribe regional specific subjects to the extent of 25% weightage of the syllabus thus making architectural education more appropriate, and regional specificities are included in the learning. Even with this relaxation, institutes and universities could never do justice to the art and culture of their own states. Poor replica of traditional architectural expressions with no scientific study as to its performance and understanding of the meaning encrypted has been happening for a long time. Such poor reproduction attempts only lead to lower the status of our own wisdom! Parallel to this, new generation architects fixed their eyes on western expressions, with the production of 'iconic' architecture with much use of steel and glass. This was a wrong attitude promoted by the political authority that invented Chandigarh as a symbol of emerging India! In reality, architects are promoted to think of modernism; even at the cost of our cultural wisdom and knowledge that gains unique expressions for the nation. Now the implementation of ECBC and GRIHA has influenced the architecture of energy efficiency. The cost of energy is skyrocketing and countries are hard-pressed to look for alternative energy and resources. Architects can no more stand imbecile before such pressing needs. The cross-discipline movement must be a norm and architects, and architectural institutions must promote this type of learning which will protect the profession from future perils.

The curriculum model is, therefore; vastly similar all over the country with minor permitted regional differences. The duration of the course has been of five years *(10 semesters)* with 'office or practical training' of six months duration integrated. Pandemic has struck the aspirations of in-office training and cognitive exposure to the site and construction badly. Learners are forced to listen to long hours of online instructions with loss of much needed professional support. In effect, the essence of practical office training is lost all its qualities. Over the early periods, the Practical Training was scheduled during the eighth semester which yielded the much-needed office exposure and practical experience that widened the student's perspective and their understanding of the domain. However, in recent days profit-motivated, industrialized associations of schools of architecture in various states have combined practical training with the final semester dedicated to the thesis project, making it profitable for the institutions, not the learners. However, there are institutes like IIT where the thesis is extended over the last full year stretching over the 9th and 10th semesters and ensure contact with professors and professionals alike. This is in the best interest of the learners even though; the mode of

delivery and curriculum and syllabus revisions are to be designed for imparting empowerment with the proper mode of delivery, DIY projects, and appropriate continuous evaluation system.

TYPES OF SUBJECTS AN OVERVIEW AS PER COUNCIL OF ARCHITECTURE (COA)

Study the curriculum of CoA reveals the percentage distribution of various component subjects, of which the core design takes a bulk of 45% weightage (Table: I).

Table I: COA Guidelines for 'Type of Subject'

Sr. No	Overview of Courses	Requirement	Percentage
1	Professional Core Courses (PC)	Compulsory	45%
2	Building Science and Applied Engineering (BS & AE)	Compulsory	20%
3	Elective Courses A. Professional Elective (PE) B. Open Elective (OE)	Can be chosen for the pool of courses	 10% 5%
4	Professional Ability Enhancement Compulsory Courses (PAECC) A. Professional Ability Enhancement Compulsory Courses (PAECC) B. Skill Enhancement Courses (SEC)	Courses approved by the Institution/University which will add value to the program and enable the overall development of the student	 15% 5%
Note: Where it is not possible to offer open electives, Professional Electives may have a weightage of 15% of the total credits.			

Source: *CoA Minimum standards of Architectural Education submitted to MHRD*

What is lacking is the integration of professional core subjects with Building science and applied Engineering subjects. If the design studio integrates itself with the research and findings of the Technology and Engineering subjects then that would lead to an invention or the development of an acceptable design product. It is also important that the presence of social and cultural studies be given importance. Every problem in design shall have a theoretical base and application of relevant would make a reasonable blend of all leading to a culturally relevant design product. Although the basic materials of construction are taught, a DIY-mode project is essential to take cognizance of the materials. Further, Newer materials along with their advantages and disadvantages shall be introduced to the learners at appropriate levels. Interaction with professionals and the construction and manufacturing sectors are much more important from the second year onwards. Interconnectedness with industry and manufacturing sectors can be furthered by professional bodies like IIA. CoA can offer these chances too to the young aspirants.

Table II: The Suggested List of Courses under each Groups

Professional Core			
1	Basic Design and Visual Arts	8	Human Settlements Planning
2	Architectural Design	9	Housing
3	Architectural Design Thesis	10	Landscape Design
4	Architectural Graphics and Drawing	11	Site Planning
5	History of Architecture and Culture	12	Carpentry and Model Making Workshop
6	Principles/ Theory of Architecture	13	Specifications, Cost Estimation and Budgeting
7	Urban Design		
Building Sciences and Applied Engineering (BS& AE)			
14	Building Materials	19	Building Services
15	Building Construction	20	Surveying and Leveling
16	Applied Mechanics	21	Acoustics

17	Structural Design and Systems	22	Environmental lab
18	Climatology	23	Environmental Science for Architecture
Elective Course (EC)			
24	Theory of Design	34	Sustainable Cities and Communities
25	Vernacular Architecture	35	Building Performance and Compliance
26	Interior Design	36	Architecture of South East Asia
27	Art Appreciation	37	Architectural Design with Steel
28	Art in Architecture	38	Architectural Design with Glass
29	Graphic and Product Design	39	Furniture Design
30	Contemporary Processes in Architecture	40	Appropriate Building Technologies
31	Architectural Journalism	41	Earthquake Resistant Architecture
32	Disaster Mitigation and Management	42	Architectural Conservation
33	Green Buildings and Rating Systems	43	Building Systems Integration and Management
Open Elective (OE)			
A	**Professional Ability Enhancement Compulsory Courses**		
44	Professional Practice	46	Project Management
45	Internship/ Practical Training	47	Dissertation /Seminar/ Research Methodology
B	**Skill Enhancement Courses**		
48	Communication Skills	51	Digital Graphics and Art
49	Computer Studio	52	Entrepreneurship Skills for Architects
50	Building Information Modelling	53	Foreign Language

Source: CoA Minimum standards of Architectural Education submitted to MHRDA

CURRICULUM AFTER GLOBALIZATION

The introduction of computer-assisted design in the mid-1980s toppled hierarchy in many design offices. Software quickly collapsed the method and process of form generation and technical production and the newest employees were the most often the most experienced in digital work. Design schools in India mostly took a fundamentally systems and logical approach to problem-solving rather than a purely artistic point of view with a few exceptions like Sir J. J. College of Architecture in Mumbai, CEPT in Ahmadabad, and School of Planning and Architecture (SPA) New Delhi. However, with the dominance of the IIT system of learning in architecture, the 'rational systems approach' prevailed. In this approach, teachers strive to induce the scientific and rational outlook in students originating with a flow chart, the methodology which clearly indicates the logic, feedback, and interaction of subsystems and the system behavior as to how it should lead to logical problem-solving. It could be observed that in this point of view, bare creativity which is artistic in nature took a back seat. However, the long practice of this system of design education also has induced boredom in learners, which now calls for creative problem-solving. Added to this, the shift of interest of students to fetching and the search of industries including professional firms in architecture for employable candidates necessitates a new approach to sustain the interest of the learners and to ensure long time survival of the profession.

Creativity is to be able to look at any kind of problem and its proposed solutions in different ways, as well as to be able to produce multi-choice solutions in a short period of time. Creativity is a key skill required for design professionals that can be developed and it could be managed systematically. Creativity gives you a competitive advantage by adding value to architects' service or product, differentiating one's business from the competitors. Without creativity, one is at a large disadvantage in the commodity hell of consumerism. The process is more of nurturing creativity through a series of projects that require critique and close interaction. Nurturing human relationships and discourse requires appropriate settings. The setting is a space enclosed with elements in the right relationship. The absence of Setting is a strong reason for heterogeneity and stress build-up. Great Architects are no exception (Fig. 1)!

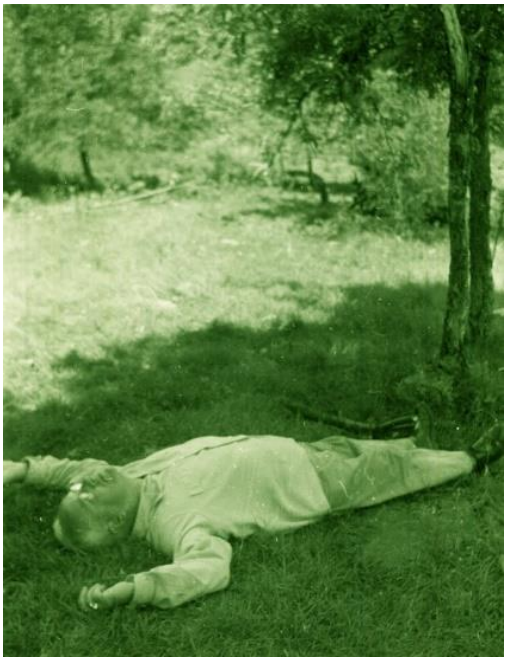


Figure I: Buckminster Fuller: *exhausted and at crossroads!*

Discourse is at the center of such type of design learning where the cognitive approach yields its merits and the learners get empowered. As always, this cognitive and discourse-based learning generates a knowledge tension; *the tension between, the known and the unknown*, which results in learning. There are three components of creativity namely *expertis*e i.e. knowledge, *creative thinking* skills which are noveltyand imagination, and *motivation* which can be intrinsic; influenced by the work environment and extrinsic; tangible rewards. It is proven through many studies that the power of symbolic thinking in design. Graphic thinking and teaching will impart the notion of abstract which prompts to think about the matter being taught (Kendrick). It is important that instructional materials shall be symbolic in nature where at least one symbol will direct the learners to be motivated to reflect and be creative with the matter being taught. Digital medium and its use will provide ample possibilities for the creation and use of such instructional materials. Discourse may be initiated into the various aspects of an interactive design studio with such instructional materials and learners may be asked to find creative interpretations in any given problem in all its strength. This way group interaction may be brought into the class which is also guided and moderated by learned faculty members. This way one major project could be divided into two parts; the creative synthesis and the design and detailing. In part one, engagement with professionals, site visits, industrial participation, and exposure to the domain of pertinent knowledge could lead to a useful and interesting design phase where the learners will enjoy and be motivated to innovative designs that are of worth.

SURVEY AND ANALYSIS OF RESULTS AMONG FINAL YEARS OF B. ARCH PROGRAMME

In order to understand the problems facing empowerment in architectural learning, a survey was conducted among the final year students of B. Arch programme in a reputed institute. The study started off with the question of identifying the expectations of students while they decide onthe B. Arch programat the beginning of their career. It was not surprising that everyone aspired for highly paid jobs. However, the field reality shows that unless empowered with the necessary skills and knowledge, no firm will offer highly paid jobs. Further, students have identified nineteen areas of concern as listed in Table III, of these six concerns the 'empowerment' that they get during the course period of five years. It is interesting to note that in an institute offering B. Arch along with other B. Tech courses, *which normally get placed with higher packages,* the students of architecture are concerned with equal opportunity and pay package as their peers enjoy. Moreover, architecture is a slightly expensive course as believed by many, since it involves an independent thesis and five-year duration as against four years in B. Tech courses. On furtherer analysis, it is important to note that 80% of the students are either fully dissatisfied or at various levels of dissatisfaction regarding their expectations from the current B. arch programme at the final year level. Further, a considerable percentage of students are opting for branch change or placement with MNCs in allied fields or in management and marketing.It is alarming that not more than 30% of students would like to choose their profession architecture, but sail away to related subjects or management or research in higher institutes in search of better pay packages. This trend has already percolated into the system that the beginners take much interest in 'minor' subjects than their 'major'.The National Education Policy

aptly lays stress on cross migration and even a degree in 'minor' where the learners may find better opportunities (India).

Table III: Expectation when Students Joined for B. Arch Programme

Sr. No	Students Response regarding expectation when they Joined B. Arch Programme
1	Highly-paid job: empowerment
2	Information accrual
3	Reputation: empowerment
4	Learning to design effectively: empowerment
5	Branch change: *option for other streams*
6	Designing according to own opinion
7	Opportunities same as other departments
8	Innovation: *empowerment*
9	Soft Skill Development
10	Real practical work
11	Masters in a foreign university
12	Starting own firm: *empowerment*
13	Preparing for CAT/other exams
14	Graphic Design
15	Placements: *empowerment*
16	Infrastructure
17	Connections
18	Sufficient Open Elective
19	Equal Opportunities

(Source: Authors)

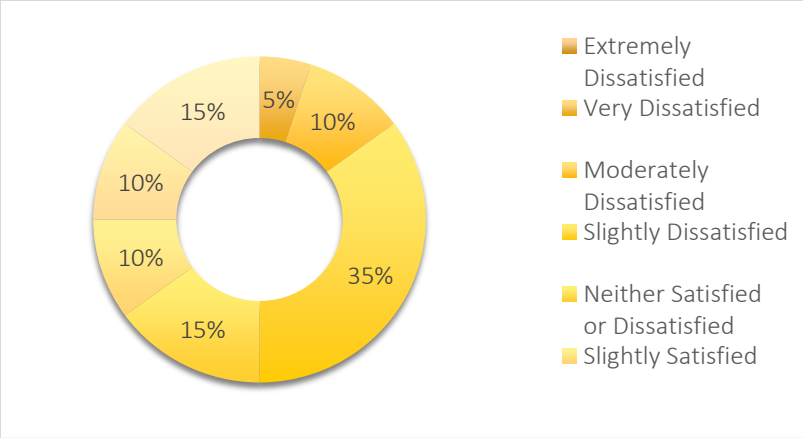


Figure I: Students Expectation from B. Arch Course
(Source: Author)

One of the highest problems that students face in the classroom is communication. There is no wonder since the student groups in the mass education system are drawn from a heterogeneous background and exposure. It shows an alarming 75% of students experience communication problems in class in one-way lecturing mode that is the predominant mode of delivery.

This indicates the absence of discourse and interaction that are key parameters of empowerment. It is important that these essential parameters are brought back to classrooms especially in design-related subjects. One might think of even another appropriate spatial setting that will facilitate interaction

and discourse among teachers and the taught (Fig: I). The next problem facing empowerment is that of cognition. Cognition requires the joint effort of all five senses of perception whereas the preferred lecturing mode of teaching considers majorly sight and hearing. Regarding the demonstration of key issues in classrooms, 50% of students feel satisfied, leaving the other 50% unsatisfied or they do not get the required level of knowledge and understanding. To offset this problem, design classes often encourage site visits and case studies. However, the inclusion of such is limited due to the prescribed time limits in the semester and the expected outcome in order to justify the spending and management, especially in private schools. This is very serious especially in the wake of the decision by the concerned schools to merge professional training ad final year thesis.

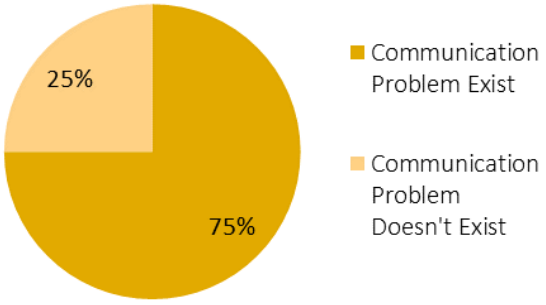


Figure II: Communication Problem
(Source: Authors)

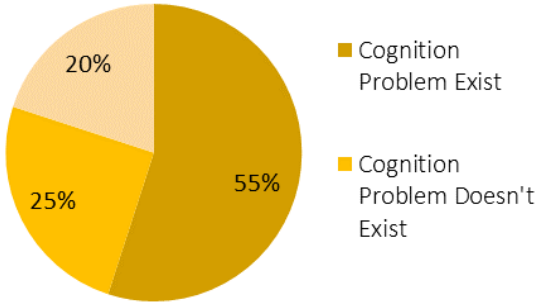


Figure III: Cognition Problem
(Source: Authors)

Another important problem the students face is internship placement. Not many architectural firms are willing to appoint interns since they themselves are facing problems of existence and also the interns do not possess the required level of skills and knowledge so as to be employed profitably. Fig: D shows that 40% of students face problems of rejection from architectural firms regarding internship that is mandatory as per the prescriptions of CoA. This reputed Institute solves the problem with the support of alumni, collaborative institutes, and professional friends. However, in many schools of architecture, the perils of lack of empowerment for the students prevail. Hence the need for the hour is to create Cognition-based curriculums that evoke interaction and discourse which leads to learner empowerment.

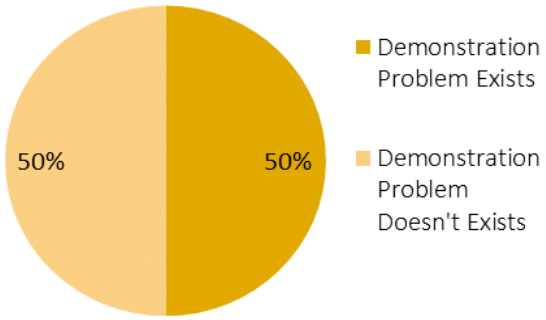


Figure V: Demonstration Problem
(Source: Authors)

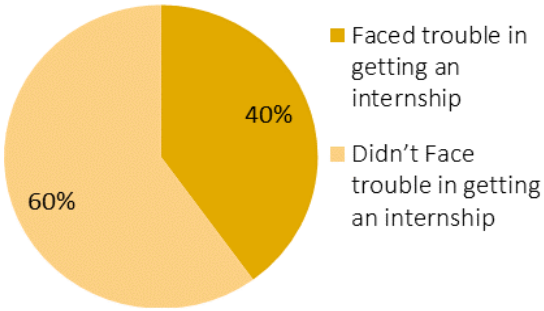


Figure VI: Trouble Faced in getting an internship
(Source: Authors)

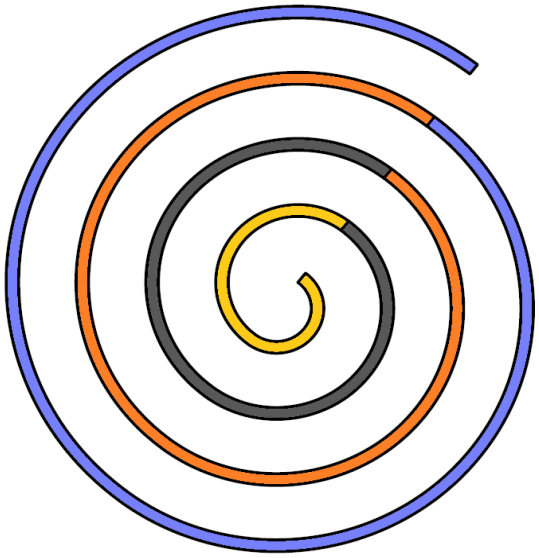
COGNITIVE LEARNING

When the creative ability is developed, especially in the first years of design education, each time students come across a design problem in the following years, they might be able to come up with a visual-spatial idea early in the pre-design phase, and then sketch the concept related to the major idea, concretize them in preliminary designs which then they probably finalize in projects. In this process of understanding the use of symbols and graphics that are abstract shall be promoted with an explanation to each. This will expose the level of understanding and the student may be asked to present such to the class and check the level of heterogeneity involved in the symbols or graphics. Cognitivestyle may be defined as an individual's consistent approach to organizing and processing information during thinking logically and creatively; *beyond the set framework*. Style does not appear to be related to the logic of intelligence but reflects 'qualitative' rather than 'quantitative' differences among individuals in their thinking processes. However, the *systems thinking* shall be brought-in to cognitive thinking to make it pragmatic enough to be acceptable to the practical world outside. If this approach is diluted, then the designs could land up in nothing less than an abstract dream. As the design matures, the logical system thinking has to take over creativity, ensuring the play of forces of nature, economy, industry, and the realities of the practical world. More so, the moldable grey matter lies in the first 3 years it would be most appropriate to track the learners rather than to *push the final years to creative problem solving* since they are already matured to handle projects in the way of creative problem-solving. It would thus be seen clearly that *systematic, cognitive, and discourse-based learning* in the initial years imparting the much needed creative and logical abilities paving the way for learner empowerment.

WHY NOT A SHIFT IN TERMS OF ENABLING CURRICULUM?

A shift from the unpacking; *knowledge dumping,* of familiar normative assumptions 'to show the status as such' towards more transgressive where truth claims are connected to existing power relations and their varied social effects (Portzen). Understanding of how and why people think, the basis of reasoning, and decision making are central to the designer's expression itself. Producing a *'stress conflict'* thus culminates in critical thinking, understanding, and social life with its expressions for which argumentation and debate serve as a positive vehicle. However, the geography of thought compels one to think culturally as in the case of *linear thinking* or *cyclical thinking*; each has its own merits and demerits (Nisbett).This is where the National Education Policy lays stress on the culture, content, and mode of education for empowerment (India). The education in architecture; it is high time, to take cognizance of the changing world scenario and make it more systematic and cognition-based, in order to generate empowered professionals and blur the divide between practice and teaching. Cognition-based teaching lays much importance on the setting, method, and perception of learners over lecturing which is one-way communication. Figure VII gives much insight into this type of pedagogy where space and settings enhance the reception and processing of matter being learned. Discourse, symbolic communication, use of interactive tools for communication, spatial designs that enhance sensory perception, presence of landscape elements are all important to generate and sustain interest in learners.

Dialectical techniques are of particular importance to design educators and students where the question of *'how aims and intentions are designed and achieved'* is the kernel and idoneous to match *'intends and ends'* in the educational process. No more the *"philosopher kings who can bring beauty from heaven to earth"* are the dictum in this globalized, networked, plural world powered by computers and industries (Portzen). However, idoneity is required to meet the intents with the needs of the stakeholders especially where there is *'symmetry of ignorance in all stakeholders'* in this highly networked world. Idoneity possibly could be derived through subjection to severe tests of intellectual enquiries organized around dialogues or dialectical critique. In any case, an alternate cognitive method is to be sought out to bring Idoneity; *a process of continuous dismantlement and reinvention of the academic system*, in architectural education.



Traditional Teaching
Involvement of Sight and Hearing

Cognition
Involvement of senses. Sight, Hearing, Touch, Smell, Taste and Reflecting

Interference of Ideas/ Discourse
- Reflection of Knowledge
- Knowledge Acquisition
- New Knowledge Production
- Knowledge Updation

Learner Empowerment
Learner empowerment is a result of holistic and *Cognitive-Based pedagogy*

Figure VII: Traditional Teaching Vs Cognitive Learning for the Learners' Empowerment
(Source: Authors)

DESIGN EDUCATION; TRANSFORMATION TO CREATIVE ARCHITECTS

There is a common tendency to masquerade creativity with originality because both involve newness. Permutations and combinations of modules in prefab-buildings are classic examples thatare necessitated from the basic requirement of industrial production; *standardization,* leading to mass production. However, mass production leads to identity loss, but factory-made products have specified quality and strength which onsite production lacks in many cases. Although there are very few absolutely original ideas that are unique, the majority of that which appears to be original are brought together from previously existing concepts in a new way. In certain cases, the lack of exposure to the nebulous ideas and concepts prompts one to think of a certain idea as the original. Especially in this networked world of information, a smart student can easily trick a teacher by a mimic. Instances of such smartness exist in the professional world, maybe the result of smartness exercised in academics! Unless the curriculum is designed based on *discourse and cognition with an effective continuous evaluation process,* the learning process will not be empowering. If the case is so, it will be resulting in unemployable graduates, and the profession will be lost in the annals of history. In order to prevent this from happening, it is high time to make the architectural education discourse oriented and cognition-based and will lead to the formation of empowered professionals. To this end, the responsible stakeholders in every nation and India in particular shall work together.

CONCLUSION

It is assertedthat if the future professionals trained through the university system of education in architecture is to get the acceptable survival and success in the world outside, reaping the opportunities and encountering threats of globalization; *they must be not simply taught,* rather be empowered to take up the vastitude of problems and special problems; be it design, research or consultancy in architecture and allied fields. Studies among students reveal a frustrating scenario with the encountering problems of internship, longer duration of course with higher expenditure. However, the prospective architects are met with lower employability, lower pay packages which have resulted from the lack of empowerment from the B. Arch programme through which they got trained in traditional ways of lecturing. The curriculum may be appropriately conceived and structured to make way for the students to crossover to their chosen areas of interest. The six-year professional master's

program in architecture with an exit point at the third-year level could be thought of as a cure to an array of existing problems of employment and choice to pursue one's own chosen field of specialization. Therefore, in this explosive situation, it is highly important to look for an appropriate cognition-based empowering curriculum. Much research has to be done to make the curriculum cognition-based, with even looking for appropriate spaces that will facilitate interaction and discourse, leading to empowerment. This visionary approach alone will bring back the lost glory of the profession of architecture. Further, if empowerment is to happen, along with curriculum, teaching mode shall be a cognitive-based process that brings discourse and interaction back into the universities. All stakeholders, governments, and industries shall join hearts and hands to see this academic revival in architecture to happen.

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AN INSIGHT INTO THE HOUSEKEEPING PRACTICES OF SRI LANKAN HEALTHCARE FACILITIES IN PRIVATE SECTOR

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Abstract
The inferior performance in housekeeping services has contributed to distinguishable levels of patient dissatisfaction. Therefore, similar to primary processes like medical treatment in healthcare sector same attention should be paid on secondary processes such as housekeeping services by the management. Moreover, the knowledge on housekeeping services is critical to plan and design proper housekeeping mechanisms in healthcare facilities. Therefore, this paper aims to explore the nature of housekeeping services in order to design proper housekeeping processes for private healthcare facilities in Sri Lanka. This research follows a qualitative research approach to examine the current housekeeping practices by adopting case study strategy. Semi structured interviews were conducted with seven respondents of the selected three cases from the private sector and direct observation method was used to better understand the housekeeping procedures. The results revealed that even though the bed capacity belongs to three groups, the housekeeping practices remain almost similar and the housekeeping in hospitals is essentially based on infection control and hygiene rather than aesthetical appearance compared to other facilities. Furthermore, the key differences such as absence of key designations such as upholsterers, painters, wall washers and catering team in the hierarchy and the absence of floor plans and area responsibility plans in the housekeeping divisions in Sri Lankan context were determined by comparing the research findings with the literature sources.

Keywords: *Healthcare Facilities; Housekeeping; Processes; Infection Control*

1. Introduction

The researches point out that an unclean healthcare environment can contribute to the increase in the risk of infections to patients (Dancer, 2004). Boyce (2007) highlights that the factors such as the ability of microbes to remain on the surfaces of the hospital areas, how often the pathogens get contaminated to the highly touched surfaces in the hospital and the number of pathogens in the hospital areas contribute to the transmission of infections in a healthcare setting. The environmental hygiene level of healthcare facilities is ensured through a chain of interconnected activities, which are critical to the infection control (Malik, Cooper and Griffith, 2003). As explained by Sherlock et al. (2009), the adequate removal of pathogens and microorganisms from the healthcare environments is crucial to minimize the spread of diseases, which contributes to overall hygiene. As indicated by the findings of Andaleeb (2001), the hospitals should always have a clean and pleasant environment in a proper order to satisfy their customers. Sevin (2018) points out that the housekeeping services provided by a particular hospital is different from the provision of medical treatment, which is its primary service, but essentially has a positive effect on the quality of medical service provision, patient satisfaction and attitudes of the patients.

There is a noticeable shortage of the housekeeping staff who are competent in human resource management, financial management and housekeeping operational skills, which create barriers in innovations related to housekeeping, and this leads to a failure of appreciation in housekeeping service aspects such as people, finance and operations (Anthonisz, 2014). Due to the high level of focus on the primary processes, the activities, which are supportive to the primary process such as housekeeping receives a low level of attention as they do not directly contribute for the income generation in healthcare environments (Horrevorts, et al., 2018). There is a distinguishable satisfaction gap of the hospital occupants related to the cleanliness and housekeeping performance of Sri Lankan Hospitals (Senarath et al., 2013). As there are very limited researches conducted in relation to the housekeeping practices of Sri Lankan healthcare facilities, there is a need to explore the nature of housekeeping services in order to design proper housekeeping processes for the local

healthcare facilities. Therefore, the aim of this paper is to examine the current housekeeping practices in Sri Lankan private sector healthcare facilities.

2. Literature Review

The satisfaction of customers relating to housekeeping services can be identified as significant in determining the customer loyalty (Kandampully and Suhartanto, 2000). The American Hospital Association (2006) highlights that the housekeeping hierarchy of a large hospital consists of important key positions such as Executive housekeeper, Assistant housekeeper, Painters and wall washers, Linen room staff, Upholsterers, Housekeeping supervisors, Maids and Porters.
Further, within the housekeeping organisational structure in ward management as explained by May and Suckley (2005), the facilities manager supports the care team by supervising the ward housekeeper and the cleaning team by assigning relevant duties such as cleaning, catering and linen management. The ward sister also manages the care team and their support staff simultaneously with the facilities manager. Both the facilities manager and the ward sister should effectively plan and communicate for the proper functioning of the ward housekeeping team.

The American Hospital Association (2006) classifies the major housekeeping activities done in healthcare environments as indicated in Figure 1.The housekeeping activities have been classified as daily cleaning activities, which are essential to day to day operation of the hospital environment, periodic cleaning activities, which are performed to maintain all the elements in the environment in a proper order, and upkeep maintenance performed to enhance the lifetime of various components of the hospital setting.

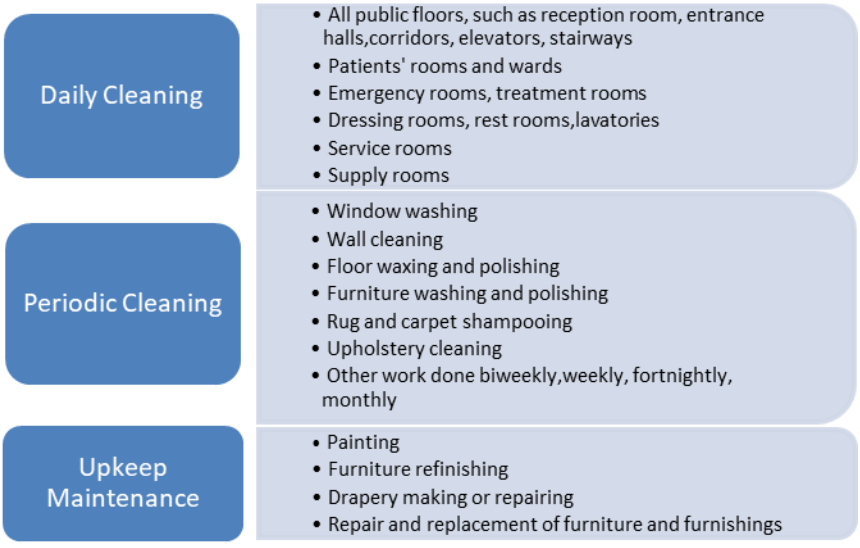

Figure 1, Housekeeping Activities (Source: American Hospital Association)

Furthermore, Wiggins (2014) described the five (05) typical areas of cleaning and housekeeping services as general cleaning, waste disposal, janitorial work, window cleaning and deep cleaning. Moreover, the author classifies the cleaning methods used in healthcare sector into major five (05) categories as physically clean, chemically clean, bacteriologically clean, entomologically clean and osmologically clean. Specifically, entomologically clean means the absence of harmful insects such as pests and the absence of surface dust and debris on all surfaces of the healthcare facility. Moreover, the term osmologically clean refers to the absence of any organic or inorganic matter which emits an odour and this is the level of cleanliness needed in intensive care units, operation theatres and food

processing industries. When a particular area is osmologically clean, the probability of transmitting harmful pathogens are reduced to a great extent.

The general areas of pathogen accumulation in a hospital environment as indicated by the Ministry of Health and Family Welfare (2015), are the bed, bedside table, bed linen, bed frames, bed rail, floor, pillow, telephones, call bell, bedside locker, curtains, stationary, mattress, television, pressure machine, key board, stethoscope, sink, tv remotes, couch, door handle, thermometer, bathroom, faucet handle, toilet commode, tables, dustbin, and window frames. Ministry of health and Family Welfare (2015), further mentions that hospital cleaning should be carried as per the following guidelines presented in Table 1.

Table 1 : Area cleaning of healthcare facilities

Area category	Frequency of cleaning	Level of cleaning
High risk areas	Once in 2 hours with spot cleaning as based on the requirement	Cleaning and intermediate category disinfection
Moderate risk areas	Once in 4 hours with spot cleaning based on the requirement	Cleaning and low category disinfection
Low risk areas	Once or twice in a shift with spot cleaning	Cleaning only

(Source: Ministry of health and Family Welfare)

Furthermore, Wiggins (2014) mentions that the cleaning and housekeeping equipment and materials are of a wide variety such as floor buffers, robotic controls, backpack vacuum cleaners, ionators, water poles, blade driers and floor scrubbing machines. Additionally, the author highlights that the cleaning chemicals can be ranging from acidic to alkaline solutions, which are categorised as detergents, sealants, and solvents. Jones (2008) explains that an executive housekeeper should possess important documents such as division of work document, area responsibility plan, floor plan layouts and the criteria for workloads.

3. Research methodology

This research follows a qualitative approach by adopting case study strategy in order to obtain the necessary information on the housekeeping practices of Sri Lankan healthcare facilities. Three (03) Cases (A, B, C) were selected from the private healthcare institutions located in Colombo district with seven (07) respondents (AR1, AR2, AR3, BR1, BR2, BR3, CR1). The Case selection was done based on judgement subjected to the resource limitations and access limitations. The Case A was a large scale healthcare facility (400 beds), the Case B was of medium scale (260 beds) and the Case C was of small scale (60 beds). All the Cases have received ISO 9001 certification and possess both in house and outsourced housekeeping service staff. The Case study boundary of this research can be identified as the healthcare sector and the unit of analysis can be highlighted as the housekeeping services in the healthcare sector. The data collection was carried out through the semi structured interviews using an interview guideline as the data collection tool. Direct observation was also used as a data collection tool in order to obtain a proper understanding of the housekeeping procedures. Other data collection methods were not considered because the suitability of those methods did not match to the research outcome. The respondents covered multiple designations related to the housekeeping service management as indicated in Table 2.

Table 2: Summary of Interview Respondents

Case	*Respondent*	*Designation*	*Years of Experience*
A	AR1	Executive Housekeeper	31 years
	AR2	Assistant Housekeeper	18 years
	AR3	Senior operations manager (outsourced)	20 years
B	BR1	Chief Operating Officer	15 years
	BR2	Assistant manager (Quality Assurance)	7 years
	BR3	Facilities Manager (Quality Assurance Division)	4 years
C	CR1	Facilities Manager	20 years

The collected data were analysed using cross case analysis technique by focusing on important areas in relation to the existing practices of housekeeping services in the local context.

4. Data Analysis and findings

The existing practices of the housekeeping departments in the healthcare sector was identified using the interviews focused on the three (03) Cases A, B and C. Findings were discussed under main headings of structure, work processes and significance of services in the housekeeping department.

4.1. THE STRUCTURE OF THE HOUSEKEEPING DEPARTMENT

The initial section of the semi structured interview guideline was focused on obtaining a proper insight into the background of the housekeeping function in a healthcare environment. As explained by all of the respondents, the housekeeping department of a healthcare setting consists of linen room, laundry and cleaning sections. The Executive Housekeeper of Case A (AR1) stated, “There are outsourced companies like outsourced pest control, gardening and cleaning under housekeeping”. The Chief Operating Officer of Case B (BR1) explained, “There is a Central Sterile Supplies Division (CSSD) linked to housekeeping”. The Facilities Manager of Case C (CR1) mentioned, “There is a housekeeping store under the housekeeping department”.

According to the respondents AR1, AR2 and AR3 of Case A, the executive housekeeper oversees housekeeping operations and under him the housekeeping supervisors, linen assistants and operational level staff is prevalent. While explaining the hierarchy of Case B, BR1 mentioned that, he is the Chief Operating Officer (COO), who oversees the housekeeping function and other functions of the hospital. The housekeeping manager is under the COO and there are five (05) housekeeping supervisors reporting to him. Under the housekeeping supervisor there are about 45 janitors who are at the operational level of the hierarchy. In the Case C, the housekeeping department is a sub section of the facilities management department and it has different functions such as laundry, cleaning and stores. The respondent CR1 explained the hierarchy of the department as, “The facilities manager is the head of the facility department and there is an executive housekeeper under him who looks after the linen and laundry division. There are operational and administration staff under the executive housekeeper”. The designations explained in the literature such as upholsterers, painters, wall washers and catering team were not mentioned by the respondents. Even though, the designations of the top management and housekeeping staff in each case is slightly different, the functions and responsibilities of the positions remained similar in all the Cases. Basically, this hierarchy is formed around the different housekeeping functions in a healthcare setting such as cleaning, linen and laundry, stores and additional outsourced functions such as gardening and pest controlling. By considering all those inputs a concept organisational structure of a housekeeping division developed for a Sri Lankan private sector healthcare environment is illustrated in Figure 2.

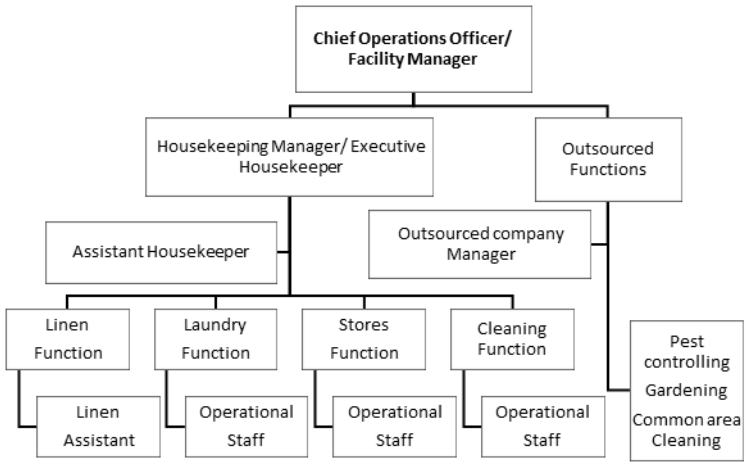

Figure 2, organizational structure of the housekeeping department

4.2. WORK PROCESSES OF THE HOUSEKEEPING DIVISION IN HEALTHCARE SECTOR

According to the interviews based on the selected Cases, four (04) main work processes were identified within the housekeeping department. They were Cleaning process, Linen and Laundry process, Waste Management process and Stores Management process. Moreover, the supportive processes such as documentation, chemical usage and testing were also visible in the housekeeping division. The following sub sections discuss each process in a detailed manner.

4.2.1. Cleaning Process

All the respondents stated that, cleaning is a vital function undertaken by the housekeeping department and the work done through the cleaning division has a high level of value addition to maintain the hygiene of the hospital environment. The Executive Housekeeper of Case A (AR1), explained that the cleaning frequencies in relation to Case A are twice a day for patient rooms, ward cleaning once a week and heavy duty cleaning in annual or once in 6 month intervals. In relation to Case B, the Chief Operating Officer (BR1) stated that the daily cleaning is done three (03) times a day in the morning, mid-day and in night time for critical areas such as Intensive Care Units (ICU) and Heart Command Centre by performing normal housekeeping activities such as mopping, sweeping and washroom cleaning. The deep cleaning is done once a week and scrubbing is done in monthly intervals. Similar arrangement could be found in Case C as well. The cleaning frequency of critical areas in Case A was lower than Case B and C due to the high level of patient occupancy and staff shortages. The cleaning staff were wearing shoes, gloves, uniforms, caps and carried a linen bucket in all of the Cases, which demonstrated adherence to the personal safety and hygiene standards and specific cleaning intervals around the day was found in all three cases. Another interesting finding was, the allocation of a special colour coding system for cleaning equipment used in the specific areas in the hospital. As highlighted by the respondent AR1, the colour blue for rooms and public areas, red for washrooms, yellow for ICU and theatres and green for cafeteria and kitchen is being used. The Facilities Manager of Case B (BR3) explained the existing practice for equipment separation as, “There are separate mops used for infected areas, which are not colour coded but labelled and separated”. The colour coding system has been effectively used in Case C to segregate the cleaning equipment, which is somewhat similar to Case A as, blue (corridors, Temporary Surgery Unit, office areas, ETUs, radiology offices, all public areas), red (washrooms, bathrooms, showers, toilets, wash basins and bathroom floors), yellow (surgery ward, ICU, labour room, neo natal ICU, theatre, lab areas, isolation areas, mortuary, Phlebotomy) and green (kitchen and cafeteria). In Case A, Case B and Case C, there are different cleaning functions, which are performed by the outsourced staff but commonly those areas were of a non-critical nature.

4.2.2. Linen and laundry process

The linen and laundry process was present in all three (03) Cases. The Assistant Housekeeper of Case A (AR2) stated, "All linen is collected twice a day by linen and laundry staff and special procedures are followed in collecting, washing and issuing linen". As mentioned by AR1 and AR2, the chemicals used for the laundry operation are detergent, neutralizer, liquid sour, alkaline builder duty liquid, chlorine and bleaching powder. The operation of the laundry function in Case B has some similar aspects with the Case A. Additionally, the Assistant Quality Assurance Manager of Case B (BR2) stated, "After washing the linen, for the sterilizing purpose they send it to the autoclave, which is linked to CSSD". The activities done in the laundry are quite similar in Case A, B and C. Moreover, Facilities manager of Case C (CR1) stated, "germed or contaminated items are going through two wash cycles", which is different from other Cases. Additionally, the matching of the soil linen to clean linen is carried out in the linen room area in Case C along with issuing of uniforms to staff members three (03) times a day. Further, CR1 highlighted, "Fabric Softener, slash destroyer for oils, Oxy Splash for bleaching, emulsifier and detergent are used as laundry chemicals".

4.2.3. Waste management process

The waste management function is inevitably linked to the housekeeping department because it is connected to the cleaning function. As explained by AR1, there are two main types of waste in a relation to Case A, named as hazardous and non-hazardous waste. The infectious waste, clinical waste, sharp items, pharmaceutical waste and radioactive waste can be considered as hazardous waste and paper, plastic, and biodegradable waste are non-hazardous waste. The respondent AR1 mentioned, "The waste is collected using a World Health Organisation (WHO) accepted colour coded bin system in operating theatres, ICUs and other areas where the hazardous waste is generated". The colour coding system uses orange for plastic waste, red for glass waste, black for general non-infectious waste, yellow for infectious waste and green for biodegradable waste. The colour codes in Case B are different from Case A in few areas, which are identified as yellow with red stripe (sharp waste), Orange 1 (recyclable plastics), Orange 2 (other plastics). The colour codes of Case A and C are of a similar nature. The food waste is sold to a private company to prepare pig meals. Paper, plastic polythene and, other waste is directly handed over to the municipal council. The sharp waste boxes and hazardous waste are incinerated in all three (03) Cases and the other types of waste are disposed through the involvement of the Municipal Council. The additional work processes related to the housekeeping division apart from the above mentioned four (04) key work processes are discussed in the following sections in an extensive manner.

4.2.4. Stores management process

The stores function is aligned with the housekeeping operations in Case C and it was not present in the other two Cases. Respondent CR1 mentioned, "The items in the stores are hand towels, toilet rolls, garbage bags, disposable cups and housekeeping chemicals". As elaborated by CR1, the goods are purchased to the stores through issuing a Purchase Request Form (PRF) and audits and checks for the stores are performed by the main office of the hospital.

4.2.5. Documentation process

The inputs from the respondents of all the Cases suggested that documentation is an important aspect within the housekeeping service management of a healthcare facility. The documents used in Case A as explained by AR1, AR2 and AR3, included housekeeping checklists dedicated to different areas in the hospital, attendance registers of staff, Inventory records of linen, furniture and furnishings and standard operating procedures for the housekeeping department. In the Case B, the documents maintained are similar to Case A, but the use of checklists are expanded. BR1 explained, "Room cleaning checklist, critical area cleaning checklist and a washroom cleaning checklist are maintained by supervisors, janitors and the housekeeping manager for daily operations". Furthermore, BR2 stated that, monthly calendar, documents for daily cleaning and deep cleaning, housekeeping manual, infection control manual and Joint Commission International (JCI) standards are the documents used in Case B. The performance measures listed for the housekeeping department of Case B are proper management of issuing chemicals by authorized persons, dilution of chemicals according to ratios,

proper distribution of cleaning equipment with proper replacements, on the job training, proper maintenance of records on housekeeping department and timely maintenance and monitoring of all the areas of the hospital. The documents used in Case C were similar to Case A as per the information provided by CR1. Even though, the literature suggest that the executive housekeeper should maintain floor plan layouts and area responsibility plans those were not available in any of the Cases.

4.2.6. Chemical usage and testing processes

All the respondents emphasised that the proper chemical usage and testing ensures the efficient provision of housekeeping services. The respondent AR1 mentioned that, the chemicals mainly used in the housekeeping department are toilet bowl cleaner, all purpose or surface cleaner, air freshener and glass cleaner with zero ammonia. The chemicals used in Case B according to the standard operating procedure document were sanitizer, all-purpose cleaner, glassware cleaner, air freshener, tile cleaner, toilet bowl cleaner, Clorex bleach, GC 100 (to be used at the garbage disposal and outside), bleach powder, Calcium Hypochlorite (TCL),floor sealer and floor striper. Respondent CR1 mentioned the same types of chemicals used by the other two Cases for the housekeeping functions.The biological testing or culture testing is performed in theatre, ICU, Surgical rooms and Surgical wards in Case A and Air conditioning plate tests are done for microbiological growth in Case B. The culture test is done in the laboratory before a critical operation such as kidney transplantation in Case C. By considering the testing practices of all Cases, it is evident that a high level of focus is given for the culture tests in Cases A and B, when compared to Case C. As Case C only performs culture testing before critical operations, the risk of contamination during minor surgeries and other medical procedures might not get captured more often.

4.3. SIGNIFICANCE OF HOUSEKEEPING SERVICES IN HEALTHCARE SECTOR

The housekeeping services in healthcare sector are fundamentally different from other facilities such as shopping malls, offices, hotels, educational institutions etc. Importantly, respondent AR1 stated, “if you think about the hospitals, we have to go to the infection control and hygienic side more, because the appearance and the cleanliness of course should be there, but more than that, infection control should be there”. Respondent AR2 stated a different viewpoint regarding healthcare sector housekeeping services as, “The customer in a hospital is different than other facilities and they have a different set of expectations”. The respondent BR1 had a statement, which supported the idea provided by AR2 as, “Mainly we are dealing with the patients and when we are dealing with the patients, our hospital and facilities should be in really high standards at any given time”. CR1 supported this idea by stating, “The doctors, patients and other parties also pay more attention to the safety, hygiene and hazard control”, highlighting the occupant expectations in a hospital. Therefore, it is evident that the healthcare housekeeping is at a critical and a distinguishable stage when compared with the housekeeping divisions of the other facilities.

5. Discussion

The level of hygiene in a healthcare environment can be escalated through the efficient planning of housekeeping services. The results revealed that the hierarchy of Sri Lankan healthcare housekeeping divisions are quite similar to the literature findings, which amalgamates different functions such as laundry, linen handling, stores, cleaning, pest controlling and gardening. Even though, the literature highlights that the positions such as upholsterers, painters, wall washers and catering team in the housekeeping hierarchy, these were not included in the Sri Lankan context because those functions are handled specifically by the maintenance division or outsourced contractors, in the healthcare setups. Therefore, it is evident that the Sri Lankan housekeeping divisions are not competent enough to include the maintenance activities into their scope. The catering is usually a separate function related to the hospitality services. The findings highlight that the critical areas of each healthcare organisation, which are cleaned more frequently and thoroughly, are handled by the in house housekeeping team to maintain a high level of hygiene, even though some non critical areas are handled by outsourced staff. linen and laundry function in each hospital is contributing to the infection control through thorough disinfection of infected linen items which are responsible for the spread of pathogens. A key feature in the waste management of all healthcare settings is the colour

coded waste separation methods. Sharp waste and infectious waste are new categories of waste, which are only identifiable in healthcare organisations. The documentation and chemical handling functions can be identified as supportive housekeeping functions in all of the cases, which ensures the proper performance of housekeeping activities in a healthcare environment. Floor plan layouts and area responsibility plans were not available in Sri Lankan healthcare housekeeping divisions because the management hasn't dedicated enough time to develop those complex housekeeping planning tools. The stores management function was only present in one case, which indicates that generally that function is connected to the purchasing division of a healthcare setup. The results indicate that the healthcare housekeeping function is different from the other types of facilities because the end customer is the patient, who expects a high level of hygiene and infection control in the target environment.

6. Conclusions and Way Forward

This paper focuses on the existing housekeeping practices of the Sri Lankan private sector healthcare facilities. The literature findings provide a general idea on the housekeeping services. The findings of the qualitative study revealed information about the existing structure of housekeeping department including the key designations, the work processes (cleaning, linen and laundry, waste management, stores management, housekeeping documentation and chemical handling and testing) and the significance of housekeeping services in healthcare sector. Even though the healthcare facilities were from different scales, the functions performed by the housekeeping divisions remained almost similar. It was also found that the healthcare sector focuses more on infection control and hygiene compared to other facilities based on the opinions of the respondents. Those results were discussed in comparison with the findings of the literature survey to identify the key differences in the practices. This research would be beneficial for the industry practitioners to gather detailed knowledge to properly manage the housekeeping divisions, to assist in the planning of housekeeping services, to develop new strategies to enhance customer satisfaction and to understand the critical nature of the healthcare housekeeping services. The facilities management practitioners who are new to the healthcare industry could also utilise the findings to determine the differences in housekeeping services in healthcare facilities compared to other organisations and adapt themselves to better manage the housekeeping services in healthcare sector to effectively generate cost savings. Finally, the paper looks at the current practices of housekeeping function in healthcare sector in order to develop a performance measurement model as the next step of the study which promotes service quality and efficiency of the healthcare facilities.

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APPLICABILITY OF INNOVATIVE BUILDING MATERIALS FOR WALL STRUCTURES TO MAXIMISE THE ENERGY EFFICIENCY OF BUILDINGS IN SRI LANKA

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Abstract
The CO2 emission is increased globally and the building sector is playing as the major industry with approximately a half percent. The carbon emission of building materials is directly affected by the energy efficiency of the building. Energy has become a limited resource in the whole world and all the sectors try to minimise their consumption to overcome the energy-related issues. Also, the selection of building materials for wall structure is playing a major role due to the highest surface area, to make a better indoor environment within the specified and required level of performance. As a result, Innovative Building Materials (IBMs) for wall structure has emerged. Even though it is currently practiced worldwide, it is not much familiar in Sri Lanka. Therefore, this research aims to identify the applicability of IBMs for wall structures of buildings in Sri Lanka. Primarily, a comprehensive literature survey was done. Three expert semi-structured interviews were carried out for the pilot survey as the foundation for data collection. Then, a questionnaire survey was done among building-related professionals and collected data were analysed using the Relative Important Index (RII). As the finding result, hollow blocks and EPS wall panels only familiarising in Sri Lanka. Finally, challenges and strategies to overcome when selecting IBMs for the wall were recognized.

Keywords: *Innovative building materials; wall structures; energy efficiency; Sri Lanka.*

1. Introduction

Greenhouse gas emission and environmental damage are increasing with the globalization and development of the construction industry where significant usage of energy resources and energy-wasting is happened (Liu & Mi, 2017). Further, the authors mentioned that buildings involve a double impact on the environment when they consume energy around 40% while emitting greenhouse gasses in 30% worldwide. The higher ranked CO2 emission sector is buildings as 46.7% and building materials are performing the main role in the building sector to emitting CO2 to the environment (Cantor & Manea, 2014). When energy has become a limited resource in the whole world, all the sectors which are consuming energy trying to minimise their energy consumption due to the issues such as increasing of energy demand in worldwide, energy security, increasing of energy cost, and requirement of reducing environmental damage (Gratia & Herde, 2004). Also, most of the resources are consisting of carbon in this century. However, it has resulted in high CO2 emission and environmental pollution which is led to global warming (Aurangzed & Jana, 2016). Also, when the carbon emission is high, the energy efficiency of the building goes down (Kumanayake, et al., 2018). Thus, to mitigate this problem all the countries try to minimise the usage of high carbon emission materials for construction purposes and as a result, Innovative Building Materials (IBMs) have been considered under the green building concept (Arun, 2013). There is a number of ways to maintain the required level of indoor thermal comfort and energy consumption in buildings by using IBMs instead of traditional building materials (Gracia & Cabeza, 2015). Therefore, the selection of building materials is playing a major role to make a better indoor environment within the specified and required level of performance (Gracia & Cabeza, 2015). Building materials that are reclaimed by reusing, recycling, reducing and, low impact on the environment are considered as green material (Hsiou, et al., 2016).

These IBMs can be developed by using plant fibers, recycled, and reusable wastes, phase change materials and photochromic glass to maximise the passive energy-efficiency of buildings (Miami University, 2005). There are many experiments conducted for designing more energy efficient building materials (Javanovic, 2017) and the lifecycle energy effect should be considered when

designing and developing innovative materials (Kuijk, et al., 2018). A building consists of many elements such as foundation, wall, roof, floor, doors, and windows with their unique functionalities (Flores, et al., 2019). Primarily, compared to the other building elements, the wall has the highest surface area which can be effectively used to saving energy by using IBMs for the wall. According to Merwe (2012), the external wall is used as a thermal resistant element to the building which helps to maximize energy efficiency with natural warming and cooling by reducing cost related to mechanical warming and cooling in the building (Merwe, 2011). There are many numbers and variety of building materials used for wall structure worldwide, both, natural and manmade (Jaehun & Jehean, 2016).

When it comes to the Sri Lankan context, there is a need of utilizing innovative materials to conserve energy. To promote using energy-efficient building materials, government authorities are followed some codes and standards to provide a guide to building material selection and promoting constructors to use energy efficient building materials (SLSEA, 2009). Even though fewer of IBMs are used in Sri Lanka and there are no sufficient strategies to maximise the energy efficiency of buildings for using IBMs which are practiced worldwide. However, there is a research gap between IBMs usage for walls and maximising energy efficiency. Hence, this study aims to identify the applicability of IBMs for wall structures of buildings in Sri Lanka, The structure of this paper begins with literature synthesis and continues with the method of study. Then, research findings and discussion and ended up with a conclusion.

2. Literature Synthesis

Day by day demand for energy in the world pursues scholars and researchers to pave the way for a positive change along with innovative replacement option (Danish, et al., 2018). Also, the learning process and technology go towards innovations that can be achieved many perspectives (Tangkar & Arditi, 2000). Furthermore, the authors said that along with many years with the time invisible environmental damage was increased while the construction industry is looking for innovative solutions. Additionally, reducing inside air temperatures, releasing fewer pollutants, improving air quality, saving energy, and increasing the comfort of residents in buildings are beneficial for the use of IBMs (Aslani, et al., 2018). Thus, the following table 1 shows a summary of some IBMs for walls.

Table 1 Innovative Building Materials for Walls

Materials	Descriptions
Insulated Wall	Designed to minimise the energy consumption of buildings in a higher level of external heated area, decrease thermal bridge effect and maximise the cost-effectiveness of buildings. (Jaehun & Jehean, 2016).
Trombe Wall	It is constructing as a 20-40cm thick thermal wall fixed to the brick or concrete wall to effectively use of energy for heating and ventilation (Jovanovic, et al., 2017).
Phase Change Material (PCM)	The inclusion of PCM in the concrete structure reduces the effect of outdoor temperature variations on the indoor surface temperature. This is due to the higher heat storage capacity and lower thermal conductivity of MPCM-concrete. Concrete used in PCM heat resistance level is decreased compared to the normal concrete due to the heat storage property of the material. That can be make the cooling zone inside the building with lower heat temperature and outdoor will keep remaining heat zone (Cao, et al., 2018).
Hollow Blocks	There are cavities inside the block to transfer the heat through the block, it is helped to maintain the proper ventilation inside the building with the proper relationship with the outside of the building to improve the energy performance of the building (Mohammad, et al., 2011: Maskell, et al., 2018).
Recycling Green	These are designed using renewable energy sources, Recycled plastics, polythene,

Building Materials	papers, fibre, timber, and rubber can be used as recycling green building material to the building projects (Chang, et al., 2016).
Bamboo Scrimber And Laminated Bamboo	Bamboo is using as building material to the wall since history, but compared with the strength and heat of other materials, using pure bamboo was reduced. Thus, treated bamboo was detected. The bamboo scrimber and laminated bamboo are heavily processed before testing. In particular, the impact of heat treatment performed on the material to achieve a caramel colour. Natural coloured bamboo will provide a better understanding of the effects of heat treatment on the strength of the material (Sharma, et al., 2014).
Concrete Mixed with Wheat Straw	Agricultural production leaves behind it a considerable amount of waste; the most common agricultural waste is wheat straw. It was made of two components which are plain concrete and wheat straw as reinforcing material. it was proved with experiment result that there are new opportunities to use agricultural waste as wheat straw in the development of new construction materials by using wheat straw new building materials can be realized and obtain similar features as classic materials (Cantor & Manea, 2014).
Recycled Plastic Lumber (RPL)	Recycled plastic lumber is made using recycled plastic wastes, helps to reduce cement contribution and also the solution for plastic wastes. It can be used as structural as well as the non-structural material. RPL does not lead to corrosion or insect attack will make sure the durability of the material and non-homogenous cross-section leads to preparing the cooling process (Herrera, et al., 2018).
Eco-Wall System	Paper-based wall systems have been designed recently for the use of interior walls in commercial buildings (Johnston, et al., 2005).
Pollution Absorbing Bricks	It has a two-layer facade system, with the specialist bricks on the outside and standard insulation on the inside the breath brick sucks the pollutants in the air and releases filtered air. In the canter is a cyclone filtration system that separates out the heavy air particles from the air and collects them in a removable hopper and design is very similar to a vacuum in which the design of breathing bricks can be configured in a wall with a window and a cooling system as well. It is a technology that can be easily applied to the current construction processes (Akbar, 2019).

Challengers of using IBMs for wall structure are related to the technical knowledge and awareness among people about innovative projects and products. To gain the technical knowledge and aware people of IBMs, there should be a proper process of communication between researchers, material designers, material suppliers, and end-users (Lee, et al., 2019). Thus, to overcome the challenges of IBMs used to maximise energy efficiency in Sri Lankan buildings can be fulfilled by using strategies. Key areas such as technical, legal, economic, social, and environmental can be taken to make strategies (Matheson, 2019) to enhance the Sri Lankan applicability of IBMs. Many certifications and assessment methods of energy efficiency in buildings are developed worldwide and can be taken legal validation to IBMs design, produce, and usage through those kinds of certification tools. BREEAM, LEED, ISO 26000, GREENSL rating system, and Eco-labelling system are major tools that can be taken to make strategies to Sri Lankan applicability of IBMs to maximising the energy efficiency of buildings. Moreover, when using IBMs for wall structures it can be certified as an environmental friendly project under the Code of Practice for Energy Efficient Buildings in Sri Lanka was compiled by the Sri Lanka Sustainable Energy Authority (SLSEA) upon reviewing and amending the Energy Efficient Building Code (SLSEA, 2009). Institute of Eco-Labelling (LIOE) under the Sri Lanka Green Building Council is issuing “Eco-Labelling” for sustainable building materials to promote local manufactures to design building materials with green features and promoting the usage of green building materials under the certification (GBCSL, 2019).

3. Research Method

The aim of this study is to identify the applicability of IBMs for wall structures of buildings in Sri Lanka. Primarily, a comprehensive literature review was conducted to collect a foundation knowledge on the topic and a quantitative approach was selected to continue the research to check the applicability of the literature finding to the Sri Lankan context. Then, three expert semi-structured interviews were carried out for the pilot survey to validate the findings of the literature review and finalise the questionnaire. A questionnaire survey was designed and distributed directly and via email. The sample was selected according to the involvement level of the profession to the IBMs usage in the buildings. The target population is 45 and the sample composition is architects, Civil Engineers, Building Material Designers, Product Developers (Building material), and Facilities Managers respectively with the target respondent numbers 12, 12, 8, 8, and 5. But the response rate was 82% and among those respondents, 61% were being in the building industry in 0-5 years, due to the innovative and green building sector were developed very recently in Sri Lanka, 22% were completed 5-10 years while 17% of 10-20 years of experience. Relative Importance Index (RII) was used as the data analysing technique which could help to rank the factors according to the importance level to the reference. The importance level of the RII categorized into seven levels to analyse data more sensitively due to some factors were differed at a minor level. Those seven RII value ranges with important levels are 0.90 ≤RII≤1 as Strongly Important, 0.75 ≤ RII ≤ 0.89 as Very Important, 0.60≤ RII ≤ 0.74 as Important, 0.45 ≤ RII ≤ 0.59 as Moderately Important, 0.30 ≤ RII ≤ 0.44 as Unimportant, 0.15 ≤ RII ≤ 0.29 as Very Unimportant, and 0 ≤ RII ≤ 0.14 Strongly Unimportant.

$$RII = \sum Wi\,Xi / \sum Xi \qquad (1)$$

Where, Wi = Weight is given to i^{th} response, Wi = 1, 2, 3, 4 and 5, Xi = occurrence of the i^{th} response and i = response category - 1, 2, 3, 4 and 5 for strongly disagree, disagree, neither agree or disagree, Agree and strongly agree respectively.

4. Research Findings and Discussion

This section consists of three sub-sections such as traditional building materials, IBMs, and challenges and strategies.

4.1 TRADITIONAL BUILDING MATERIALS

Traditional building materials which are commonly used in Sri Lanka were identified and those materials respectively with RII ranking order such as Brick (0.917), Concrete (0.833), Glass (0.761), Timber (0.611), Plywood (0.606), Gypsum Board (0.517) and Stone (0.506). Accordingly, bricks are used as the building material for wall structure in Sri Lanka most of the time. In conclusion, there is no material under 0.44 and all are above 0.505. It can be validated that above mentioned seven materials are currently using in the building projects in Sri Lanka. Table 2 illustrate the ranking of the reason for the selection of these building materials. Among that, six were identified through literature and validated in the pilot survey. Moreover, availability in the market and appearance were added in the pilot survey.

Plywood is widely used as a building material for partition walls these days in Sri Lanka due to its unique characteristics. Timber is a high-cost building material but most clients like to the appearance of timber. Therefore, plywood has been designed to overcome those barriers. It is clear that plywood is selected as a secondary solution for timber with availability in the market, low cost, and low maintenance. Gypsum boards are used as interior walls or partition wall material. Most of the professionals are selecting the gypsum board due to the lightweight quality of the material. But in this study weight is not considered as a factor. Therefore, from the other factor gypsum is selected due to

the low maintenance requirement and low cost rather than having a wall with other material. According to the results of the RII of collected data, energy efficiency is not considered when they selecting Gypsum as a wall material.

Raw materials for the brick manufacturing industry are easier to find in Sri Lanka. Therefore, a wide variety of bricks are easier to find in the Sri Lankan market. That is the main reason for selecting brick as wall material by many professionals which are consisted of strongly important RII. Also, the cost is also lower when compared to other factors. However, Glass has low energy efficiency than others due to thermal radiation are directly affected as heat gain through the glass and it is led to high air conditioning cost.

Table 2 Reasons for the selection of building materials (Traditional & Innovative Building Materials)

No	Reason	Traditional Building Materials														IBMs	
		Concrete		Timber		Plywood		Gypsum board		Stone		Brick		Glass			
		RII	Rank	RII	Rank	RII	Rank	RII	Rank	RII	Rank	RII	Rank	RII	Rank	RII	Rank
1	Structural Strength	0.917	1	0.572	5	0.344	8	0.506	7	0.978	2	0.817	3	0.411	5	0.85	2
2	High Durability	0.894	2	0.544	6	0.417	5	0.511	5	0.989	1	0.794	4	0.672	3	0.872	1
3	Low Maintenance	0.878	3	0.4	8	0.667	3	0.533	1	0.872	5	0.722	5	0.294	8	0.778	5
4	Low Cost	0.833	4	0.478	7	0.689	2	0.517	2	0.300	8	0.861	2	0.600	4	0.822	3
5	Availability in the market	0.828	5	0.744	3	0.844	1	0.511	4	0.744	6	0.972	1	0.944	1	0.767	6
6	Environmental Friendly	0.689	6	0.767	2	0.372	7	0.511	6	0.978	3	0.600	8	0.300	7	0.661	8
7	Energy Efficiency	0.650	7	0.628	4	0.400	6	0.506	8	0.642	7	0.606	7	0.333	6	0.822	4
8	Appearance	0.644	8	0.917	1	0.417	4	0.517	3	0.956	4	0.717	6	0.911	2	0.733	7

Thus, selecting building materials for wall structure mainly consider the structural strength and durability of the materials.The professionals who are working on selecting building materials activities, select bricks and concrete as wall material for their projects in Sri Lanka. According to the results of the reasons for selecting wall building materials, there is no strong importance for energy efficiency. Most of the professionals are focusing on cost, market availability, and structural strength as basic functions when selecting materials for wall structures in Sri Lanka.

Other than the properties of the material there can be used other methods affected by selecting the building materials for the wall structure. The pilot survey findings have been included the main five methods for selecting building materials for wall structure in the RII ranking respectively such as Client's requirements (0.922), Evaluate Life cycle cost (0.778), Heat gain calculation (0.5), According to building materials rating system (0.467) and Embodied energy calculation (0.411). Accordingly, the client's requirement is a strongly important factor that is highly considered compared to the other methods. Evaluate life cycle costs can be considered as a very important factor. Other all three methods are indicated that the energy efficiency of the building was considered during the building material selection stage. But heat gain calculation and building material rating system given by the green building council are considered moderately important. According to the findings of the literature review, embodied energy calculation should be calculated before selecting a building material. But RII for embodied energy calculation can be revealed as 0.411 that is indicated as an unimportant factor for respondents. According to the findings of the pilot survey, most of the professionals are considered about properties of the materials and then analysing LCC to matching the client's cost-benefit requirement.

4.2 INNOVATIVE BUILDING MATERIALS

In the Sri Lankan context, how professionals familiar with the IBMs for wall structure was identified through the questionnaire. Many projects used hollow blocks and EPS wall panels as an innovative material for wall structure to minimise the energy consumption in the building which most of the respondents were involved in. The Eco wall system which was identified in the literature review is used moderately. Bamboo and laminated bamboo, Concrete mixed with wheat straw, recycled plastic lumber, and Trombe wall are not much familiar with Sri Lankan practice. Building materials designers and material developers are familiar with those materials, but when it comes to the applicability, there is less motivation towards those materials. Table 3 shows the RII value of those identified innovative building Material usage for the wall structure.

Table 3 RII of innovative Building Materials

No	Material	RII	Rank
1	Hollow blocks	0.672	4
2	EPS wall panels	0.600	7
3	Eco-wall system	0.450	10
4	Bamboo scrimber and laminated bamboo	0.439	11
5	Concrete mixed with wheat straw	0.439	12
6	Recycled plastic lumber (RPL)	0.333	13
7	Trombe wall	0.317	14
8	Phase change material	0.294	15

In the literature review, there were identified why nowadays people looking for IBMs. It was not revealed that only focusing on energy efficiency without fulfilling other properties. According to the RII ranking energy efficiency can be identified as a very important factor (Refer to Table 3). Energy efficiency is highly considered when selecting IBMs other than selecting traditional building materials for the wall structure. When ranking both traditional building materials and IBMs usage higher ranks are taken from the traditional building materials (Refer to Section 4.1 & Table 3). Moreover, according to the response, there were identified 52% of respondents had been identified there was a major impact on energy efficiency after using innovative building material for their building projects and only 4% had been not identified any noticeable changes in energy efficiency using IBMs for the wall structure. Also, 37% and 4% respectively stated as significant impact and minor impact on energy efficiency after using the IBMs for the wall structure. Additionally, In Sri Lanka hollow blocks and EPS, wall panels are used as the energy-efficient building material for wall structure when all other IBMs which are taken into this study are located in the lowest RII rate compared to the traditional building materials used for wall structure (Refer Table 2). When it is considered about the energy efficiency level of traditional building materials with IBMs, results were revealed that IBMs are much more energy-efficient than traditional building materials. Therefore, there should have been strategies to fill the gap by overcoming the challenges of using IBMs for the wall structure.

4.3 CHALLENGES AND STRATEGIES

The following subsection describes the challenges for using innovative building material in Sri Lanka and strategies to overcome those challenges respectively.

4.3.1 Challenges

According to the results of the familiarity of innovative building material for wall structure, there are some challenges when thinking about Sri Lankan applicability. Therefore, it should be focused on following challengers, which are stated in Table 4, especially by innovative building material designers and developers, Architects, Engineers, and Facilities managers as specialist professionals in the

industry. Moreover, there are a limited number of standards related to IBMs such as Green building certificates, Eco-labelling system, ISO 9001, and LEED standards. When compared to the knowledge of traditional building materials, awareness for innovative buildings and searching for IBMs are not much considered in Sri Lanka. Therefore, the lack of information availability has been challenged for peoples who are looking for IBMs. Only 36% of the respondents mentioned that having awareness of the standards related to IBMs.

Table 4 Challenges for using innovative building materials in Sri Lanka

No.	Material	RII
1	Lack of technological knowledge on innovative materials usage	0.906
2	Difficulty of finding local suppliers	0.894
3	Lack of standards for innovative building materials	0.889
4	Not aware of maximising energy efficiency through wall materials usage	0.828
5	Limited amount and quality of information	0.828

The strongly important challenge can be validated as a lack of technological knowledge on innovative materials usage. If construction parties are not familiarised with the technology related to the innovative materials they should use, maybe they cannot fulfill the requirements of designers and developers who introducing IBMs. Also, there are some clients who are looked for maximising energy efficiency by using IBMs but difficult to find a local supplier.

4.3.2 Strategies

After identifying the challenges of using IBMs, strategies to overcome those challenges were identified in the literature review, and then get experts' opinions on those factors. There were identified some key factors through the findings of the pilot survey. RII was calculated for all the strategies under the main five categories such as technical, legal, economic, social, and environmental. And which are shown in Table 5. The lowest RII is for the BREEAM assessment method when Sri Lankan professionals were not very familiar with the BREEAM which is governed by the Building Research Establishment (BRE).

Table 5 Strategies to overcome the identified Challengers

	Strategy	RII	Rank
Technical	Durability and structural strength	0.828	1
	Design for resources efficiency	0.811	2
	Continuous maintenance	0.767	3
	Aesthetic appearance	0.694	4
	Fire protection	0.556	5
	Functionality	0.539	6
Legal	Eco-Labelling system	0.722	1
	LEED	0.706	2
	GREENSL rating system	0.683	3
	ISO 26000	0.526	4
	BREEAM	0.478	5
Economical	Increase profitability	0.867	1
	Increase productivity	0.834	2
	Sustainable procurement	0.572	3
Social	Human safety	0.844	1
	Comfort	0.739	2

	Awareness	0.766	3
Environmental	Avoiding pollution	0.861	1
	Improve energy efficiency	0.889	2
	Using natural/recycled raw materials	0.744	3

Factors in the legal strategies were got low RII compared to the other categories due to the lack of awareness on the standards and certification systems related to energy efficiency practices using building materials. But in general, all the factors of strategies were taken above 0.45 RII, which means all of them are important to the study. Therefore, all the factors can be taken as strategies to overcome those challenges.

5. Conclusion

Applicability of IBMs to maximising energy efficiency in buildings is currently practiced worldwide as one of the heat load minimisation methods for a lifetime. A wide area of external and internal surface is covered by the wall structure and most of the building projects are using high carbon emission and lack of energy-efficient materials. Thus, the building sector has been looking for IBMs to maximising the energy efficiency of buildings. Even it is not an acceptable level in Sri Lanka compared to the other developing counties. Also, it is clear that when selecting traditional building materials for projects, energy efficiency was not considered as a major factor. But in the case of IBMs selection, the energy efficiency of the building is focused more. The lack of technological knowledge on IBMs was identified as the major challenge for innovative building materials usage in Sri Lanka. Also, building users are not aware of the characteristics of innovative building material to properly using and maintaining those materials. It may be led to reducing the target outcome of materials. Moreover, it is difficult to find local suppliers for internationally recognized building materials and standards related to energy maximising using building materials are not sufficient in Sri Lanka. Finally, but not least, the initial cost is high due to a lack of government support. To overcome those challenges, some strategies have been identified under the main five categories such as technical, legal, economic, social, and environmental.

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A STUDY ON UNDERSTANDING THE SOCIAL INTERACTION ARISES FROM URBAN PARK ENVIRONMENT THROUGH DIFFERENT INTERACTION TYPES; Related to Diyatha, Katubedda and Kelimadala urban parks in Colombo district

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Abstract
In 1990s, the decrement of non-built up areas due to urbanization in Sri Lanka cause for reducing the quality of life and emerging of social issues by interruption of human interaction with the busiest monotonous life styles. The urban beautification projects like urban park concept was introduced to achieve the Sri Lankan sustainable vision by 2030 by developing those spaces as social spaces for the purpose of community gathering and interaction. With this emerging concept, there is no such consideration or the research regarding identification of social interaction types in park to increase the park planning potentials in Sri Lanka by achieving the social sustainability of the place via social interaction. Above mentioned objective of the research is overcome through the theoretical framework of "social network theory" by understanding the actor and user types in the urban park context in Sri Lanka especially for Colombo district which have dissimilarity of availability of design characteristics. The methodology of the research is consisted with onsite observations and questionnaire surveys under mixed method approach. There are different intensity of social interactions were happened in three selected parks, from these the social interactions highly occurred among adults-adults user category and the least social interaction can be seen among children-younger user category in three parks and the highest expected factor for interaction is accessibility rather than consideration other factors. Additionally, provide shady greenery areas with multi-diverse activities for all user and actor categories based on respondents' comments will be needed to consider in increasing the future planning potentials to achieve social sustainability of the urban parks via social interaction in Sri Lanka.

Keywords: *Urban parks; social interaction; social network; social sustainability*

1. Introduction

The revolution of urbanization in cities of developing countries deteriorates the liveability and the sustainability (Kasarda & Rodineli, 1990). The issues occurred due to urbanization can be overcome through the sustainable city development which is considered as an integral part in recent decades (Pacion, 2009). Social sustainability is an important component in sustainable development and social interaction is one of the factor that can be formatted the social sustainability (Dempsey et al., 2012). Meeting opportunities are important for the development of local communities and their interactions (Volker et al., 2007). Therefor the reduction of social interactions may cause for occurrence of depressive symptoms, isolation, hopelessness as well as deteriorates the quality of life (Abada et al., 2007). Social interaction begins with the space which has proper facilities and design characteristics (Poodeh & Vali , 2014). Recreational facilities like urban green spaces which generate social interactions among people (Volker et al., 2007). The green open spaces like urban parks provide wider range of opportunities to users by identifying their demographic and social parameters such as types of interactions, usage pattern and their expectations (Konau, 2016). But there are lack of understanding and problems in measuring social usage and interaction among different users and actors in recreational green open space environment (Manning, 2011). This situation can be changed through spatial planning by providing interaction opportunities in urban park planning (Rafiyan, 2002). "Planning is for people" so the core of the urban planning is to make interconnection between people and urban places. Therefore Understanding of human interactions, preferred patterns of users in urban parks provide essential platform for urban park planning and designing potentials (Faros & Ahern, 1995).

When considering Sri Lankan context, Sri Lankan cities have been rapidly expended in 1990s especially in Colombo district due to the urbanization effect. Non- built up area is highly reduced due to the higher level of urban expansion. Due to the urbanization in recent years, the urban community is suffering from overall stress attached to urban life in Sri Lanka (Haatig & Staas, 2007). As well as some of social issues such as depression, isolation immense human suffering in Sri Lanka due to urbanization occurred because of interruption of social interactions (Hettige, 2013). The urban park concept were introduced to overcome this situation and balanced inclusive green growth in Sri Lanka to achieve the sustainable vision by 2030 (Munasinghe, 2004). So the urban green open spaces like urban parks are essential component of the city and social infrastructure which defines the quality of life of the urban population in Sri Lanka. 30 % of users use the urban parks for socialization purposes such as interactions, walking and relaxation (Konau, 2016). So the urban parks have greater potentials to generate interactions within urban community in the urban context. But the planning failures are the emerging problem in green open spaces in Sri Lanka especially in Colombo district. The survey analysis of the urban parks in Colombo proves that there are lack of social activities, events for social gathering and making interactions with actor and user categories (Konau, 2016). Also these issues are diffusely impacted for weaken of social interaction among urban community. So the weaken of social interactions can be affected for the instability of the social sustainability of the urban places. Sri Lankan cities like Colombo and its suburban's main focus is to development of economic and physical dimensions rather than social dimension (Bandara, 2013). Therefore the research has not been researched yet and fill the above knowledge gap.

So the main objective of the research is to understand about different social interaction types in urban parks to increase the park planning potentials in Sri Lanka which can be achieved through answering the research questions of what are the types of social interactions in urban parks and investigate different preferred factors of users for social interaction within urban park context in three selected parks of Colombo district in Sri Lanka.

2. Literature Review & Similar Studies

The evolution of urban park has a long history which had begun from United States. That evolution was responded to more on social problems like lack of integration and expressed the various ideas about nature (Galen & Michael, 2004). The urban parks are the inclusive places which can possibly stimulate the community development and social interaction (Annerstedt et al., 2013). In Sri Lanka also main purpose of creation of urban parks is for developing opportunities meet, talk, rest, interact with people in comfortably and publically within urban areas (Hettiarachchi & Silva, 2016).

Individuals are considering as social being, there is an importance of making interactions because it highlighted the social sustainability and quality of life of the people (Puthnam, 2000). So the essential condition of the urban parks be considered that there should be social interaction happen in them (Rahnemai, 2007). However the Appearance and the physical condition of the urban parks can encourage either permitted or prohibited behaviours and the social interactions (Kelling & Wilson, 1982).

The theoretical understanding which is incorporated to the study provides better guidance to the analysis and finding section of the research. Place making concept is applicable for the planning and designing of the urban spaces. The sociability, image and comfort, uses and activities and accessibility are the important elements which increase quality an urban place according to place making concept (PPS, 2007). Recently, place making concept is linked with green space planning incorporates with functional uses (Chillers & Timmermans, 2014). The main key theory used in the study for evaluating the interaction is social network theory. The theory was introduced by sociologists in 1950s (Barner, 1954; Mitchell, 1969). In this theory, it describes the relationship between nodes (actors) and users. Social networks are starting from simple interactions with acquaintance to complex interaction with

strangers. It is useful to understand the types of interaction within a specific spatial scale. Therefor, in the research this theory is applicable for social characteristics auditing and interaction identification (checklist protocol method in behavioural mapping) in selected parks which occurs between users (children, youngers, adults, seniors) with actors (individuals, dyads and groups). Socio-cultural theory was explained that the higher functioning interactions of the urban places occurred through provision of socio-cultural opportunities (Vygotsky, 1978).

Many scholars had done many researches about urban parks and the social interactions. Also there is a need of study based on categorization of types of actors' interactions as a matrix of social interaction (Pipi, 2014). The park usage of the different actor types have to be investigated in different contexts but not the special focus is paying for Sri Lankan context (Konau, 2016). According to understanding of previous research work, this research is investigated about different social interaction types in urban parks to increase the park planning potentials in Sri Lanka by using mixed method approach for the three selected urban parks in Colombo. Further the research is applied social network theoretical understanding which is significance from previous researches.

3. Research Design

3.1. CASE STUDY SELECTION

There should be a systematic way for selecting the case studies to achieve research objective of understanding about different social interaction types in urban parks to increase the park planning potentials in Sri Lanka. So Ballester, Morata & Olmos, (2001) ; classification of identified availability of park components in Mexico city are applied for the selecting suitable case studies for the research. Through understanding of the previous research work incorporate them into the UDA classification of urban parks in Sri Lanka according to weighted scoring method. The weights are giving according to importance of components availability from the understanding of literature reviews. Weighted scoring method derives three parks with dissimilarity of availability in above mentioned components with the ranking levels of 1 (Diyatha Uyana), 4 (Kelimadala) and 7 (Katubedda park) in Colombo district for the study purpose with the availability of various types of interactions.

3.2. Data Collection & Analysis Methods

Data collection method of the study is based on onsite observations and questionnaire surveys. According to understanding of previous similar research work play areas, pathways for walking and cycling, exercise areas, seating areas, naturalistic areas and food stole areas are the selected sub locations within the parks for the observations. These selected sub areas are happened more social interactions with actor and user groups which is understanding through preliminary site observations. Initially reordered the interactions happened with user and actor categories by using protocol checklist method in behavioural mapping by dividing interactions into three levels with social network theoretical understanding. This method is most relevant method for observing the user and actor interaction patterns (Cosco et al., 2010). Questionnaire survey is targeted to 165 sample respondents who are selecting from random sampling method while they engaging their leisure activities. Questionnaire survey is used for enrich the data gathered from onsite observations during the study.

Data analysis method of the study is aimed for mixed method approach which utilized the qualitative and quantitative techniques. Those are included descriptive statistical methods and protocol checklist method of behavioural mapping by using social network theory.

4. Findings and Results

The find and results section is consisted with answer the two research question of the study which are what are the types of social interactions happened in three selected parks according to the social

network theoretical background and investigate different preferred factors of users for social interaction based on data collected through onsite observations and questionnaire surveys.

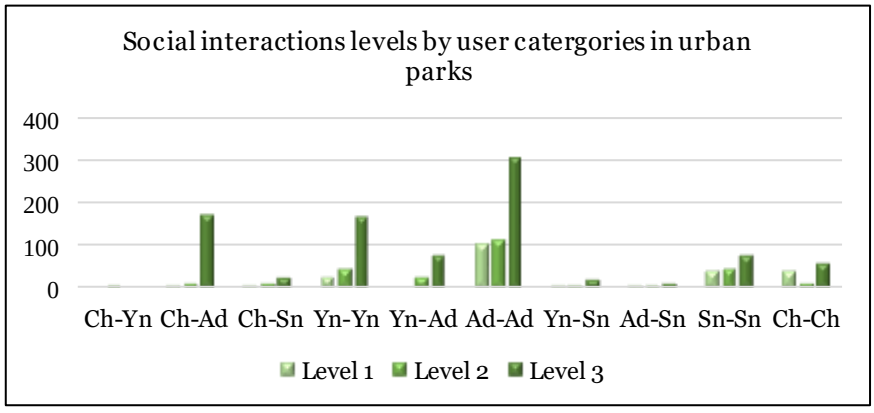
According to overview of the summery of observations in checklist protocol method of behavioural mapping incorporates with social network theory derived that the total observed interactions in three parks were 1359, it consisted with 189 (12.91%) from Katubedda, 233 (19.14%) in Kelimadala and 937 (64.22%) from Diyatha Uyana park respectively in weekdays and weekends. So these results proved that the highest number of social interactions are in Diyatha Uyana 937 (64.22%) from the total observations and least social interactions are in Katubedda park 189 (12.91%).

Table 1, Summary of the observations in three parks
(*Source: Compiled by author, 2019)*

Observations	Katubedda walkway & lake park	Kelimadala urban park	Diyatha Uyana urban park
Total observed user interactions	189 12.91%	233 19.14%	937 64.22%
Male	122 64.55%	113 48.49%	496 52.93%
Female	67 35.44%	120 51.50%	441 47.06%

Accordingly social network theory, there are actors (nodes) and users who make their interactions which are useful to understand how the social interactions occur within the social structures through observation data.

Table 2, Social interactions by levels according to social network theory
(*Source: Compiled by author, 2019)*



Three interaction levels highly occurred among adults-adults (age 18-65 yrs.) 513 (37.74%) from the total observed social interactions. The least total interactions by the user categories can be seen among children (age below 12 yrs.) -youngers (age 12-17 yrs.) which has the interactions of 3 (0.22%). Observed highest level one interactions((Short term superficial contacts among people who do not recognize each other (strangers) greet, wave, smile (less than 1 min) occurred among adults-adults with 100 (48.54%) from total level one interactions. The second level ((occurs short time period with unacquainted or familiar persons who meet randomly informal talks, greeting, taking pictures, carrying pets (1- 15 min)) 107 (43.49%) and third level ((long term contacts with close friends, lovers or relatives chatting, playing, sitting, dining, taking pictures (more than 15 min)) 306 (33.73%)

observed interactions also highly occurred among adults-adults. The lowest interactions of level one are represented among children (below 12 yrs.) - senior citizens (age above 65 yrs.) and youngers – senior citizens (age above 65 yrs.) 1(0.48%) in all the observed sub locations of three parks. Lowest level two and three interactions are occurred respectively among youngers and senior citizens which is 2 (0.81%) and among adults-seniors 11(1.21 %).

When consider about the actor types, interaction occurred with individuals and interactions occurred with more than one user (dyad or groups) can be elaborated as follows based on observations.

Table 3, Social interactions by actor types according to social network theory
(*Source: Compiled by author, 2019)*

All selected three urban park locations

Total Interactions = 1359		
Social interactions by levels	With individuals	With more than one user (dyad or groups)
Level 1	58	150
Level 2	249	186
Level 3	216	686

Level one interactions 58 (4.26%) are occurred within individuals and 150 (11.03%) interactions are occurred with more than one user (dyad or groups). Level two interactions are represented 63 (4.63%) with individuals and 186 (13.68%) are occurred among more than one user. Level three interactions highly occurred within dyad and groups which has 686 (50.47%) & individual interactions are 216 (15.89%). The total three levels interaction are derived 61.52% have interacted with dyad or with groups. Accordingly, results are interpreted that Asian country like Sri Lankan community like more to interact with dyads and groups rather be with individuals because culturally well organized activities and functions of the urban parks provide more opportunities for interacting among group of users according to socio-cultural theory.

The general demographic characteristics of the respondents who were engaging to questionnaire survey included 165 total sample from that 56.6% are males and 42.4% are females in three parks. Most of the respondents who were involved to the survey within the age category of 18-65 yrs. (Adults). When comparing to the per capita monthly income, most of them are not employees 72 (43.6%).

Based on the questionnaire survey in order to frequency analysis different preferred factors for interactions are categorized into eight. From those the highest preferred factor is accessibility with the frequency values of 10 (50%), 35 (78%), 66 (66%) in three parks. Place making concept is derived that image and comfort, accessibility are the most important characters which increase the social interaction in urban places. Therefore the accessibility to the park is the most preferred factor for the social interaction. Privacy and the security 10 (50%) is another highest preference in Katubedda park. Not preferred factor for selecting park for social interactions in Katubedda is the spatial arrangement (availability of open spaces, naturalistic areas, play areas & shady trees) which has 3(15%). In Kelimadala users responded that not preferred factor is facilities provided (seating, sanitary, lightening and food stole facility) with frequency of 4 (8.9%). In Diyatha, not expected preferred is the space allocation in the park (enough for per person=14 sq. m) which is not for social interaction. The results interpret that the preference are vary according to selecting parks for interactions.

Table 4, Demographic characteristics of respondents
(*Source: Compiled by author, 2019 using SPSS from questionnaire survey)*

	Total sample	Katubedda walkway & lake park	Kelimadala park	Diyatha Uyana park
Age				
Below 12	7(4.2%)	1(5%)	2 (4.4%)	4(4%)
12-17 yrs.	26(15.8%)	5(25%)	6(13.3%)	15(15%)
18-65 yrs.	102(61.8%)	10(50%)	30 (66.7%)	62(62%)
Above 65 yrs.	30(18.2%)	4(20%)	7(15.6%)	19(19%)
Gender				
Male	95(56.6%)	12(60%)	22(48.9%)	61(61%)
Female	70(42.4%)	8(40%)	23(51.1%)	39(39%)
Monthly income (per capita)				
Below 25 000	12(7.3%)	2(10%)	2(4.4%)	8(8%)
25 000-50 000	20(12.1%)	4(20%)	4(8.9%)	12(12%)
51 000- 100 000	41(24.8%)	4(20%)	13(28.9%)	24(24%)
Above 100 000	20(12.1%)	3(15%)	6(13.3%)	11(11%)
No	72(43.6%)	7(35%)	20(44.4%)	45(45%)

Table 5, Frequency distribution of preferred factors for interactions
(*Source: Compiled by author, 2019 using SPSS from questionnaire survey)*

Frequency Table

			Facilities Provided		Space allocated		Spatial arrangement		Design elements		Accessibility		Maintenance		Privacy & Security		Attractive visual appearance	
			Freq	Perc	Frec	Perc.	Freq	Perc.	Freq	Perc.	Frec	Perc	Freq.	Perc.	Freq.	Perc.	Freq	Perc.
Katubedda park	Valid	1	1	5.0	1	5.0	3	15.0	2	10.0	0	0.0	1	5.0	0	0.0	1	5.0
		2	2	10.0	3	15.0	7	35.0	9	45.0	1	5.0	2	10.0	1	5.0	5	25.0
		3	13	65.0	12	60.0	9	45.0	8	40.0	9	45.0	9	45.0	9	45.0	12	60.0
		4	4	20.0	4	20.0	1	5.0	1	5.0	10	50.0	8	40.0	10	50.0	2	10.0
		Total	20	100	20	100	20	100	20	100	20	100	20	100	20	100	20	100
Kelimadala park	Valid	1	4	8.9	1	2.2	1	2.2	2	4.4	0	0.0	3	6.6	0	0.0	1	2.3
		2	5	11.1	9	20	10	22	9	20	2	4.4	5	11	6	13	5	11
		3	23	51.1	22	49	20	44	23	51	8	18	22	49	18	40	29	64
		4	13	28.9	13	29	14	31	11	24	35	78	15	33	21	47	10	22
		Total	45	100	45	100	45	100	45	100	45	100	45	100	45	100	45	100
Diyatha Uyana park	Valid	1	4	4.0	8	8.0	6	6.0	5	5.0	0	0.0	1	1.0	2	2.0	2	2.0
		2	15	15.0	23	23.0	20	20.0	10	10.0	6	6.0	7	7.0	22	22.0	11	11.0
		3	36	36.0	45	45.0	52	52.0	62	62.0	28	28.0	28	28.0	36	36.0	55	55.0
		4	44	44.0	24	24.0	22	22.0	23	23.0	66	66.0	64	64.0	40	40.0	32	32.0
		Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Vales 1=Not expected 2= Moderate 3=Expected 4=Highly expected

After identifying the preferred factors the survey was targeted to get respondents comments to improve the planning potential in park planning in future to achieve more social sustainability of the place via social interactions. In Katubedda park the negative aspects need to be improved are sanitary facilities and promote diverse activities and events within the park increase the interactions. In Kelimadala Park, provide shady areas with greenery may affect for the increment of the interactions.

Especially the children areas safety and quality have to be improved and the food prices will be manageable for achieving to everyone there. Those are the comments gained from respondents which are useful to improve the park planning potentials in Sri Lanka.

5. Conclusion

The key findings of the study explored that answering to the two research questions of the study. Subsequently, answer to the research question one; what are the types of social interactions in urban parks according to social network theory interpreted in user category the highest three levels interactions are occurred with adults-adults (18-65 yrs.) user category in three selected parks and the least are among youngers 12-17 yrs.) – children (below 12 yrs.) category. According to the actor types interactions are occurred more with dyad and groups in three parks rather individuals because culturally well organized activities provide more opportunities for that type of interaction behaviours. Those different types of interactions which are divided for the three levels indicated that the simple interactions convert into complex ones with not only acquaintance but also with the strangers. The social network theoretical background provides better understanding of different interaction types between the users and actors in the urban park context. These identified interaction types should be focused for increasing the future park planning potentials in Sri Lanka. Based on answer to the question two, investigate different preferred factors for the social interactions indicated that accessibility is the highest preferred factor for interactions in three parks according to place making concept derived that it is a most important component which increase social interaction in a urban place. Also the in research finding section, respondents comment for improving diverse activities and shady areas in three parks provided more interaction opportunities within the park context by achieving social sustainability of the place.

Basically, different research found that social interactions are happening in the parks. But current research findings focused more on different social interaction types in urban parks to increase the park planning potentials in Sri Lanka within the social network theoretical understanding of protocol checklist method. Further it can be elaborated that findings are useful to urban planners, designers and decision makers who are working with built environment and community for creating urban parks with social sustainability via more interaction opportunities. The future studies should refer different parks in different context to identifying the interactions types in complex ways for effectively achieving to the park planning and designing in Sri Lanka.

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DIFFUSION OF PROFESSION IN SRI LANKAN ORGANISATIONS: FACILITIES MANAGEMENT

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Abstract
Facilities Management (FM) is the integrated management of the workplace to enhance the performance of the organization. It is obvious that competent FM will arouse effective working performance and the value of the organisation by increased employee productivity. Diffusion of Innovation (DOI) theory helps to explain the adoption process of innovation by modelling its entire life cycle according to the aspects of communications and human information interactions. Thus, this research aims to identify the influencing factors and nature of their effect on FM diffusion in Sri Lankan organisations, FM as a sample for the profession. A qualitative research approach was selected to conduct the research. A comprehensive literature synthesis was carried out at first to determine the existing data and also to develop the questionnaire survey which was designed for top management of FM adopted organisations in Sri Lanka. The questionnaire respondents were selected randomly with the available information. Collected data were analysed using manual content analysis and which was validated using a 95% confidence interval test. Research findings revealed that majority of FM adoption decision was taken in the Sri Lankan organisations by Board of Directors/ Managing Director which is authority type organizational innovation-decision and there is nothing which belongs to collective categories such as the decision of the government or any corporation or councils or board. Moreover, the Rogers generalizations regarding internal characteristics for the innovative organizations are most appropriate with the Sri Lankan FM adopted organizations.

Keywords: *Diffusion of Innovation, Profession, Facilities Management, Organisational Innovation, Sri Lanka.*

1. Introduction

Sri Lanka is a developing country whose building and infrastructure industry is rapidly developed (Lindholm, 2005). Oxford Business Group (2017) stated that there is a vast development in the construction industry of Sri Lanka since May 2009, the end of the country's civil war. Consequently, the need of a responsible person to plan, budget, allocate, design, construct, decorate, manage occupancy, maintenance, secure, redesign, rebuilt, transfer and disposal of working structures (Dhanushka, 2013). Although Facilities Management (FM) does not exist in Sri Lanka, these tasks are handled by the owners, tenants, asset manager, property manager, staff, or organisations of the working structures with different grades of success (Zheng, 2012). Primarily, almost all the organisation's main purpose is productivity maximization through increasing effectiveness and efficiency and also being competitive with their competitors, they have to fulfill the rules, regulations, codes and standards regarding the business environment (Silva H., 2011). Additionally, customer satisfactions act a major role to survive in the market as well, because of that, FM is needed to increase the productivity of the working environment without compromising the occupant's satisfaction which is one of their major roles (Gamagedara, 2014). The International Facilities Management Association (IFMA) defined, "Facility management (FM) is a profession that encompasses multiple disciplines to ensure functionality, comfort, safety, and efficiency of the built environment by integrating people, place, process and technology" (IFMA, 2020).

The good FM creates a vast enhancement in the efficiency and productivity of an organisation, its staff and customers by applying proper management techniques to provide a quality working environment with an optimum cost at the right time (Silva H., 2011).FM is not just a new name to existing practices in Sri Lanka, it's a new level which includes some functions which are carried out in the past by different other professionals and owners of the working structure, moreover, FM functions are done by different people who are engaged in core business which affects the core business and also the built environment quality and building structures (Mythiley, 2010). There are some pieces of evidence which ensure that the FM is a novel profession in Sri Lanka such as Although, seven postgraduate FM courses were existing in the United Kingdom before 2000 (Nutt, 1999), the first-degree programme was started in 2005 in Sri Lanka (Department of Building Economics, 2014). There were no professional authorizes or institutions for FM in Sri Lanka until 2009 to check the requirements of FM in a built Facility (Ranathunga, 2010). The first institution of FM profession was started in 2013, March as FM Group, then the foundation for an Institute for FM professionals in Sri Lanka was laid in 2015 and the status "Sri Lanka" was obtained in May 2016 (Institute of Facilities Management Sri Lanka [IFMSL], 2017). Also, Jones Lang LaSalle, a public company, is one of the leading FM

outsourcing companies in the world (Jones Lang LaSalle, 2017) and they arrived in Sri Lanka just about six (6) years ago to gain the first entry advantage, by doing researches on political conditions, economic trends and construction industry development of Sri Lanka (Ranatunga, 2017). Further, the profession FM is not spread widely all over the country, only a few office buildings are applied to FM (Perera, 2010). Hence, it is obvious that FM is a novel profession to Sri Lanka, an innovation to Sri Lanka according to Rogers' definition "An innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adaptation".

It is vital to know the influencing factors and their influence is important for catalysing the diffusion of FM in Sri Lankan organisations. Hence, this study aims to identify the influencing factors and nature of their effect on FM diffusion in Sri Lankan organisations, FM as a sample for the profession. The paper begins with a literature review and continued with the research methodology. Then it jumps to research finding and discussion. It is ended up with a conclusion.

2. Literature Review

This section contains 2 subsections such as diffusion of innovation and FM as an organisational innovation.

2.1 DIFFUSION OF INNOVATION (DOI)

Diffusion of innovation (DOI) is a theory, describes the process of fresh ideas, practices, objects or technologies which spread within a social system (Rogers, 2003). Dr. Everett M. Roger was a distinguished professor and researcher on DOI theory. He was the momentous developer of DOI theory and the first edition of "Diffusion of Innovation" was published in 1962 and it is in the fifth edition at present. This book was designated by the Institute for Scientific Information in 1990 as largely citied on social science journals articles (Rogers, 2003, p. 378). Accordingly, this research was based on Rogers's theoretical framework, even though, less amount of professional diffusion studies was done according to Rogers's theory.

Innovation is derived from the Latin word "Novus", mean as an idea, material, or object perceived to be new by the relevant unit of adoption (Dearing, 2009). According to Rogers's statement, innovation is a novelty that beneficial is founded by its adopters. It is a practice, object or an idea which is sensed as new by an individual or any other adoption unit and an innovation's newness not only just involves in new knowledge but it can be expressed as persuasion or adaptation decision as well, Simply says if an individual senses an idea as new, that is an innovation even though, it may have been known by someone for a certain period of time but yet they never adopted or rejected that and also not developed attitudes, favorable or unfavorable (Rogers, 2003). In addition, innovation is defined as a process of creation, development or reinvention of ideas, objects and practices which are fresh for the adaptation unit (Walker, 2006). Moreover, the important opinion developed in the 1980s is that innovation can include rather than just technology, information (Tran, 2005). Innovation is not just only about technology development, it is more than that, it can be the nature of doing business in an organization (Rasul, 2003). Additionally, Organisation for Economic Cooperation and Development (OECD) stated innovation as the implementation of the new or significantly upgraded products, services, processes, marketing methods, organizational methods of business practices or workplace organization or external relations (2005, p. 46). According to the above statements, the innovation is not limited to any boundaries, which can be an idea, product, service, practices, process, concept, behaviour or knowledge.

The word "Diffusion" is derived from the Latin word, "Diffundere", which means "to spread out" (Wikipedia). It is defined as "the spread of an innovation in a market" (peres2010). Diffusion is the process through which an innovation is communicated using certain channels over time within the social system members, moreover, it is the process of communicating the innovation for a certain period of time (Rogers, 2003, p. 11). The theory of diffusion of innovation is seen as one of the ways of perceiving exposure to new objects ideas, or practice (Ifeduba, 2010). The outcome of diffusion differs in how the DOI theory is applied (Adams & Marie, 2011). There are some alterations occurred in the

structure and function of a social system, due to certain consequences that lead when diffusion happen (Rogers, 2003, p. 6). In addition, the four main elements of diffusion are innovation, communication channel, time and Social system, which could be identifiable in all diffusion as innovation.

2.2 FM AS AN ORGANISATIONAL INNOVATION

UNESCO Institute for Statistics (2005) defined innovation as the implementation of new or significantly improved processes or goods or services, or a new method of marketing or a new organizational method in business practices, workplace organization or external relations. Organisational innovation is defined as a new (or new to relevant adaption unit) ideas, products, processes or procedures are intentionally introduce and apply within an organization or a group, give significant benefits to individuals, organizations, groups or society (Omachonu & Einspruch, 2010). The innovation's characteristics affect the adaptation changes and the degree of diffusion of innovation, as perceived by the adapting organisation (Wu, Lan, & Lee, 2011). Additionally, the characteristics of organizational leaders, organization and the environment in which it operates are the factors which affect the innovation adaption decision in an organisation (Dewett, Whittier, & Williums, 2007). In addition, in an organizational perspective, the innovation adoption may lead to flexibility, upgraded efficiency of operation, creation of better working practices and competitive advantage which confirm sustainable development of an organisation in a rapidly changing business environment (Kotsemir & Abroskin, 2013) and the innovation must merge well with the organisation, irrespective of how the organization accrues that innovation, to secure the full advantages of innovation (Hazen, Overstreet, & Cegielski, 2012). However, an organisation's operational procedures to strategic goals and business models are affected by an innovation (Ye, Jha, & Desouza, 2015). One of the generalizations of Roger validated that, generally both innovation and organisation are changed in an organisational innovation (Rogers, 2003, p. 425). Also, as stated by Rogers in his book Diffusion of Innovations (2003), the characteristics of innovative organizations were de-rived from the early organisational innovation studies and most of these are same as innovative individuals' characteristics, as example-generally large size organisations are more innovative as individuals with high socioeconomic status and high income. However certain characteristics of innovative organisations are not matching with individual innovation, as for example -structural characteristics of the organisation, which are summarized as follows with related to organisational innovativeness in Table 1.

Table 1:- Independent variables related to organisational innovativeness

Structural Characteristics		Description	Relationship
Individual (Leader)	Attributes towards change	Degree to which a leader of organisation accepts to change	Positive
Internal	Centralization	Degree to which control and power of an organization are concentrated in the hands of a comparatively few individuals	Negative
	Complexity	Degree to which members of an organisation, possess a fairly high level of knowledge and expertise	Positive
	Formalisation	Degree to which the member of an organisation is emphasized by the organisation to follow rules and procedures	Negative
	Interconnectedness	Degree to which the units of a social system are connected by interpersonal networks	Positive
	Organisational slack	Degree to which uncommitted resources are available to an organisation	Positive
	Size	Size of the organisation	Positive

External	System openness		Positive

Source: - (Rogers, 2003, p. 411)

Diffusion of FM in Sri Lanka is considered as an innovation in organisation due to be a profession and management practice. The process of innovation in organisation is much more complex than individual innovation process (Rogers, 2003).

3. Research Methodology

The aim of this research is to identify the influencing factors and nature of their effect on FM diffusion in Sri Lankan organisations, FM as a sample for the profession. The quantitative approach is subjective, understanding the sense of the human or social problem (Creswell, 2014). Suitable research techniques had to be recognized following the research approach was selected, for the operation of the research (Yin R., 2009). Data collection and data analysis are the two broad parts of research techniques (Malewana, 2009). Accordingly, the comprehensive literature survey was used to get overview knowledge about the research problem and act as a base to design the questionnaire as well. The questionnaire was the vital data collection tool and was distributed to the top management of FM adopted organisations in Sri Lanka. The respondents' selection was done using a random sampling method with the available information. 36 respondents were selected and the questionnaire was filled through face to face meetings, as a result, that the respondent rate is 94.4%. The results of the survey show that, 23%, 12% and 9% of the respondents were respectively from the commercial, factory and construction sector. Moreover, 6% of the respondents are from residential, hospital and hotel sectors. When analysing the ownership of respondents' organisations, the majority (76%) are from private limited companies and 12% are semi-government organisations. Additionally, public limited, partnership, proprietorship and government-owned organisations have less percentage (3%). In addition, the collected data were analysed by using the Manual content analysis method and 95% confidence interval testing to validate the research finding and analysis.

4. Research findings and analysis

This section consists of four sub sections such as FM as organisational innovation, changes in the organisational structure, internal characteristics of an FM adopted organization in Sri Lanka and applicability of FM in Sri Lankan organisations.

4.1 FM AS AN ORGANISATIONAL INNOVATION

The FM adoption decision in an organisation can be taken by the owner of the organisation, Board of Directors (BOD) / Managing Director (MD) of the organisation, the parent company of that organisation, any authority or due to condition applied by clients. Table 2 clearly shows the percentages of each category by whom the FM adoption decision was taken in the Sri Lankan organisations.

Table 2: Percentage of FM adaption decision makers in Sri Lankan Organisations

Categories	**Percentages**
Own decision of the owner	11.76%
Board of Directors (BOD) / Managing Director (MD)	76.47%
Decision of parent company	32.35%
Due to condition applied by the clients	17.65%
Any decision by an authority	0.00%
Others	2.94%

According to the literature findings, organizational innovation decisions are categorized as optional, collective, authority and contingent. Along with the questionnaire survey results, the Board of Directors (BOD) / Managing Director (MD) belong to Authority, the owner's own decision belongs to

optional and the parent company and the condition applied by the client are belonging to contingent. There is nothing that belongs to collective category FM adoption decision in Sri Lanka, for example - government or any corporation or councils or board. Figure 1 illustrates the FM adoption decision taken in Sri Lankan organisations along with the type of organisational innovation decision.

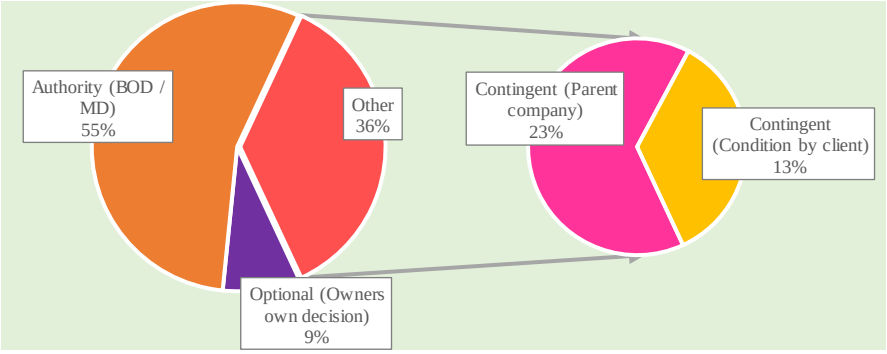

Figure 1: FM adoption decision taken in Sri Lankan organisations along with the type of organisational innovation decision.

4.2 CHANGES IN THE ORGANISATIONAL STRUCTURE

When adopting a new idea (innovation), there may be changes that occur. likewise when adopting FM in their organisation , there may be some changes that can happen in the organisational structures as well. To identify whether any changes happen in the organisational structure or not, the question was asked from the respondents.

41% of respondents specified as changes occurred in the organisational structure due to the adoption of FM in their organisation in Sri Lanka. Those changes are summarized as,

- Addition of a new position with or without direct reporting responsibility to the Board of Directors(BOD)
- Forming a new department or division for FM
- Functional reengineering of a certain portion of organisational structures (eg:-separate or incorporate department)
- Name, no of staff and responsibilities of some departments are changed.

The rest of the respondents (59%) specified that there were no changes occurred in the organisational structure due to the adoption of FM in their organisations. There were some reasons which they stated for there were no changes occurred, They are summarized as

- Incorporate FM functions with another existing component of the structure
- Adopt or require FM belong to an existing division
- Outsource FM functions and organization which are government-owned.

95% confidence interval test was done to validate the above information which is 20 respondents stated as there were no changes in the organizational structure of them due to FM adoption and got 0.4228 as the lower limit and 0.7537 as the upper limit for population portion as there are no changes in organizational structure by adopting FM in their organisations. Both limits are within the interval (0, 1). Averagely 58.82% of respondents' organisations had no changes in their organizational structure due to FM adoption in their organisation. Accordingly, we are 95% confident that the percentage varies within the range (42.28%, 75.37%).

4.3 INTERNAL CHARACTERISTICS OF AN FM ADOPTED ORGANIZATION IN SRI LANKA

Figure 2 shows the percentages of each category such as high, medium and low of the internal organizational characteristics which affect the FM adoption in Sri Lankan organisations. The generalization derived by Rogers in his book Diffusion of Innovation regarding internal characteristics for the innovative organisations is most appropriate with the Sri Lankan FM adopted organisations.

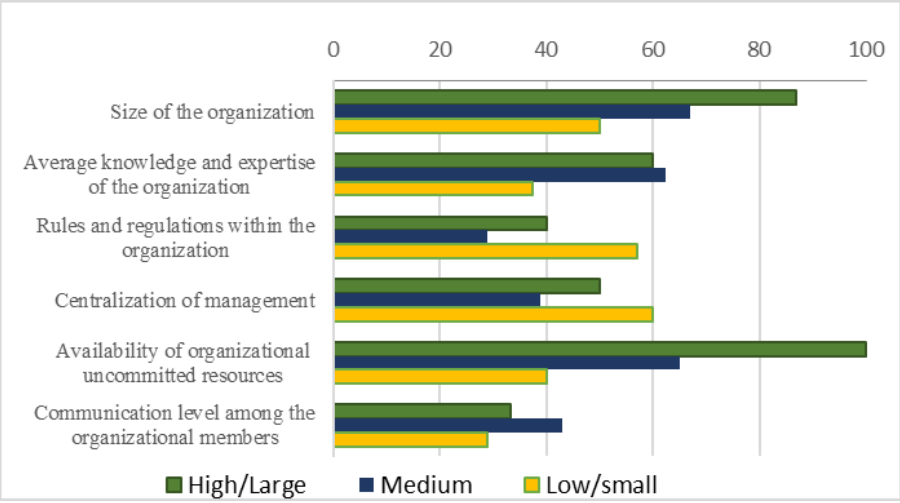

Figure 2: Affection of internal organisational factors in FM adoption decision

As mentioned in the literature section, Table 1 shows the relationship between innovative organizations and the internal organizational characteristics according to Rogers's perspective. As along with the generalization of Rogers, size of the organisation has the positive relationship innovativeness in an organisation .87% of the large organisation's respondents stated that size of the organisation is an important characteristic for the FM adoption in their organisation but only 50% of the small size organizations stated the size as a factor for FM adoption in their organisation. According to the generalization, the average knowledge and expertise of the organisation also has a positive relationship with the innovativeness of the organisation. But this survey result shows that high percentage (63%) of respondents stated as average knowledge and expertise of the organisation is a factor for the FM adoption in their organizations. Next to that, organisations having a high level of average knowledge and expertise of the organisation are sixty percentages (60%). Therefore, it concludes that average knowledge and expertise of the organisation's characteristics also compile with the generalization even though it is slightly deviated (3% only) from the generalization. Subsequently, the next two characteristics of the innovative organizations are rules and regulations within the organisation and the centralization of management in an organisation. Both of these characteristics have a negative relationship with the innovativeness of the organizations. Along with the summary of the survey, most of the respondents (57% & 60% respectively) who specified these two characteristics as a factor for the adoption of FM in their organisation are low level. So, this also complies with the generalization of Rogers.

The questionnaire survey reflects that the availability of uncommitted resources in the organisation has a positive relationship with innovativeness organisations and which is a very important factor that affects the FM adoption in their organisation. As evidence, 100% of the respondents who have a high level of uncommitted resources in their organisation stated as it are a factor for the FM adoption in their organizations. The last characteristic is the communication level among the organizational members, which has a positive relationship with the innovativeness of the organisation. The survey result gives 33%, 43%, and 29% respectively high, medium and low level of communication among the organizational members. But this shows that medium level communication among the organizational members has stated by more respondents as one of the factors for FM adoption and high level comes next to that. As a conclusion, in Sri Lankan context also internal characteristics of the innovativeness

of organizations (FM adoption in the organizations) are compiled with the generalizations of Rogers's diffusion theory which is validated from this survey result depicted in Figure 2.

4.4 APPLICABILITY OF FM IN SRI LANKAN ORGANISATIONS

When an organization discusses and decides about the FM adoption in their organizations, there are some factors that affect positively and lead to the FM adoption direction and some factors which are negatively acted in the FM adoption decision and lead to the rejection of FM adoption in their organizations. Along with the outcome of the research findings, it is obvious that the following are the critical factors that lead to adopting FM in Sri Lankan organizations are stated in Table 2. Accordingly, half of the respondents indicated the factors which make them delay adopting FM in their organizations, so those factors can be considered as the reason for the rejection or non-adoption of FM in Sri Lankan organisations, which are stated in Table 3 as well.

Table 3: Factors which lead to adopt FM and the factors which lead to reject or non-adoption of FM in Sri Lankan Organisations

Factors which lead to adopt FM	**Factors which lead to reject or non-adaption of FM**
To achieve sustainability	Lack of deep technical knowledge
To transfer the managing responsibility of property under a single hand	It is difficult to specify the scope and job description of FM
To upgrade the safety and security of the environment	The recruit procedure of FM in the first is slightly lengthily
To fulfil the standards, compliances and international certifications	Afraid about conflicts which may arise between FM and other professionals
To satisfy clients and customers	Less availability of resources
To optimize resource usage	Additional cost
To improve the FM related documentation and reports	Difficult to place the FM in the organizational hierarchy
To reduce conflict between inter departments	Unawareness about FM profession
To be competitive in the market	Resistances arise from existing employees because they may have to move out from their comfort zone.
To upgrade the quality of the utility system	

Moreover, the questionnaire survey reflects that 41% of respondents' organisations adopt FM to gain benefits to the organization but the other 59% of respondents' organisations, majority of organisations adopt FM to overcome certain problems in their organisation. It was validated using a 95% confidence interval test and got 0.3919 as a lower limit and 0.7257 as the upper limit. As these proportions are within the interval (0, 1), it is understandable that FM adoption in Sri Lankan organisations is taken place to overcome the existing issues in the organisations. The competitive advantages of adopting FM or solution by the FM adoption for certain problems in the organizations were summarized as follows;

- To improve the proper maintenance management
- Effective management of occupational health and safety
- To efficiently manage the facilities
- Improving sustainability compliance
- In order to maintain the utilities
- To reduce Space issues and optimum use of resources
- To manage Labour regulations
- To conduct the facility audits like safety audit, energy audit and to achieve standards
- Disaster management and to have a best risk assessment
- Implementation of waste management

- To fulfil client needs and customer satisfaction
- To get expert advice in incorporation of FM services

5. Conclusion

FM is the management of the working environment by the integration of people, process, and technology to support the core business with the intention of enhancing the performance of that environment. In the Sri Lankan organisations, the FM adoption decisions in the organisations are taken by the Board of Directors / Managing Director, organisation's owners, parent company and due to client condition. Among the Rogers' innovation organisational decision-making category, authority type has more than half a percentage in Sri Lankan FM diffusion and there is no collective decision-making category like government or any corporation similar to western provision organisations have to adopt FM in their organisations. Also, when adopting FM in the Sri Lankan organisations, the majority of the organisation has not made changes in their organisational structure to adopt FM. Normally in innovation diffusion, there must be both positive and negative aspects of that. Likewise, some of the critical factors which lead to adopting FM in the Sri Lankan organizations are sustainability, single management responsibility of property, FM related documentation improvisation, and competition in the market. Moreover, the internal organisational factor of FM diffusion in Sri Lankan organisations coincides with the Rogers generalisations. In conclusion, the size of the organisation and availability of uncommitted resources of the organisation has a positive relationship with FM diffusion in Sri Lanka. The communication level among the average knowledge and expertise of the organisational members has a positive/neutral relationship. Rules and regulations within the organisation and centralisation of the organisations have a negative relationship with the diffusion of FM in Sri Lankan organisations. Finally, outcomes of this research will be beneficial for the industry practitioners and also for the diffusion of FM in Sri Lankan organisations. Moreover, this will help to diffuse future fresh professional diffusion within Sri Lankan organisations.

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NEGLIGENT USE OF PERSONAL PROTECTIVE EQUIPMENT BY CONSTRUCTION WORKERS IN SRI LANKA: ANALYSIS OF INDIVIDUAL MANIFESTATIONS

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Abstract
The construction industry can be identified as one of the main sectors in Sri Lanka where the majority of occupational accidents happen. When considering the Small and Medium Enterprises (SME), occupational accidents have been significantly happened due to many reasons. Among those reasons, negligence of the use of PPE by construction workers has become prominent. Different factors can affect this situation. Among them, individual manifestations such as perceptions, beliefs, experiences and attitudes of the workers can make a significant impact. Hence, there is an emerging need to explore the reasons under these individual manifestations, which encourages the negligence use of PPE. This paper therefore aimed to analyse the individual manifestations to unveil the reasons behind the negligence of use of PPE by construction workers in Sri Lanka. A qualitative research approach was followed to achieve the aim of the study. Case studies were conducted using two SME construction projects. Fourteen semi structured interviews were conducted in both cases with managerial and worker level respondents. Collected data were analysed using code based content analysis. 'Considering PPE as a disturbance', 'lack of experiences of the workers', 'poor education level of the workers', 'inadequate knowledge and skills of the workers', 'poor income level', 'age of the workers', 'number of dependencies', 'poor health condition' and 'different lifestyles of the workers' were revealed through the empirical research findings as the key reasons under individual manifestations, which affect for the neglect usage of PPE by the workers. The knowledge generated through this study can be used in many ways by the industry practitioners to make safe working environment within the construction sites.

Keywords: *Construction Industry, Negligence, Personal Protective Equipment (PPE), Small and Medium Enterprises (SMEs)*

1. Introduction

The construction industry can be identified as a key sector, which highly affects for the economic development of any country (Ofori, 2015). Unfortunately, this sector has become one of the main sectors where occupational accidents highly happen day by day (Knibbs, 2009). As a developing country, SMEs in construction sector contribute more in socio economic development (Ofori, 2015). However, annual occurrence of occupational accidents is significantly high in this sector and this poor safety culture results different kinds of health hazards for the workers (Muema, 2017).

As same as to other countries, a similar situation can be observed in the Sri Lankan construction industry as well. Different reasons can affect for these occupational accidents in SME construction sites and among them, negligence of the workers to wear PPE is prominent because it increases the considerable amount of safety issues at the site (Ofori, 2015). PPE can be identified as equipment, which is used to minimise the workers' exposure to serious workplace hazards and injuries by ensuring their safety (Lombardi et al., 2009). Therefore, the primary concern should be given for the use of PPE in order to make a safe and healthy working environment at the sites. However, nowadays the majority of construction workers tend to neglect the use of PPE due to many reasons (Magoro, 2012). Among those reasons, workers' unsafe behaviours have made significant impact on the negligence of the use of PPE (Lombardi et al., 2009). These behaviours of the workers can differ from a worker to worker based on their individual perceptions towards safety, attitudes, beliefs, working experiences, and knowledge levels, which are generally named as 'Individual Manifestations' (Eskandari et al., 2017).

These manifestations need to be analysed in depth to determine the influence, which has been placed on the negligence of use of PPE by construction workers. Since a limited number of studies had been carried out about the negligence of use of PPE in Sri Lanka, it remains as a worthy researchable area. Accordingly, having identified the research gap, this paper intends to analyse the individual manifestations in depth to investigate the reasons behind the negligence of use of PPE by construction workers in Sri Lanka. Having identified the research gap, the research question can be formulated as

"How individual manifestations could be influenced on negligent usage of PPE among construction workers in Sri Lanka".

2. Literature Review

Sri Lankan construction industry can be identified as the most unsafe sector due to the occupational accidents, which happen constantly (De Silva and Wimalaratne, 2012). As further mentioned by them, this situation was highly apparent in SME sector as well. Many reasons can affect for these occupational accidents and among them negligence use of PPE by the construction workers has become a key reason, as disclosed by Ofori (2015). As a result, construction workers have become the main victims of these occupational accidents, nowadays (Ahamed *et al.*, 2016).

As mentioned before, nowadays, construction workers highly tend to neglect the use of PPE due to many reasons (Magoro, 2012). As further stated by the author, mainly this situation happens due to unsafe behaviours of the workers. As stated in the previous section, these behaviours are influenced by individual manifestations. Individual manifestations can be defined as the human characteristics or human behaviours, which the workers' way of working and thinking can be affected (Eskandari et al., 2017). These individual manifestations include personal attitudes, perceptions, beliefs, knowledge or experiences of the workers, which can differentiate their behaviours (Lombardi et al., 2009). The Table 1 presents the reasons emerged from these individual manifestations, which affect for the negligence of use of PPE by the construction workers.

Table 2: Reasons affect for the negligent usage of PPE by the workers

Reasons under the Individual Manifestations	***References***							
	A	***B***	***C***	***D***	***E***	***F***	***G***	***I***
1. Poor personal attitudes of the worker	√		√					√
2. Poor education of the workers	√	√						
3. Poor knowledge and skills of the workers	√	√	√			√		
4. Lack of past experiences of the worker		√		√			√	
5. Age of the worker either encourage or discourage the negligent usage of PPE	√				√			
6. Poor perceptions of the workers	√				√			

References
***A**: (Lombardi et al., 2009), **B**: (Magoro, 2012), **C**: (Wanjiku, 2017),*
***D**: (Eskandari et al., 2017), **E**: (Ogundipe, Owolabi and Olanipekun, 2018), **F**:* (Larson and Liverman, 2011) ***G**:* (Ali, Kamaruzzaman and Sing, 2010)*; **I**:* (Lundstrom *et al.*, 2002)

Ogundipe, Owolabi and Olanipekun (2018) stated that 81.1% of construction workers do not tend to use PPE due to poor personal attitudes because the majority of them perceive that PPE is inflictions for their works. According to Magoro (2012), knowledge of the workers affects the use of PPE as it refers to the basic understanding, which the workers have about the importance of the use of PPE. It was further emphasised in a recent study by Wanjiku (2017) that the level of education of the worker is one of the main manifestations, which affects the negligence of the use of PPE. Further, workers who have poor education have less understanding on the importance of wearing PPE in safeguarding their life. In addition, negligence can be encouraged due to the workers' poor attitudes. Attitudes describe their personal feelings based on their perception of the use of PPE. That means the decision of the workers to use PPE is based on their attitudes and perceptions of the risk, in the work they involve. Furthermore, workers' practices and experiences can be identified as another individual manifestation, which describe the way of demonstrating their knowledge and attitudes during their works (Magoro, 2012). The author emphasised that it can also adversely affects for the negligence of

the use of PPE by the workers because working practices can be changed by the workers by considering their past experiences.

However, when it comes to Sri Lankan context, influence of these manifestations on negligent use of PPE by Sri Lankan construction workers have not been discussed in literature yet. Thus, in bridging this knowledge gap, this paper intends to analyse individual manifestations to investigate the reasons behind the negligence use of PPE. The next section discussed the research process adopted in bridging this knowledge gap.

3. Research Methodology

Having identified the need of analysing the individual manifestations to explore the reasons behind the negligence of use of PPE by Sri Lankan construction workers, the research question was developed as,

RQ: "How individual manifestations could be influenced on negligent usage of PPE among construction workers in Sri Lanka?"

Yin (2015) clearly stated that the selection of research strategy is based on three main criteria namely the type of the research problem, up to what extent the researcher has the ability of control over the behavioural events as well as whether the researcher focuses on contemporary events or not. Since, a contemporary phenomenon was followed through an in-depth investigation in this study (i.e. an investigation of individual manifestations, which affect for the negligence of use of PPE among construction workers) within its real-world setting, with a 'how' type of research question, case study research strategy can be identified as the most appropriate research strategy. Since this study aimed to explore reasons, emerged from individual manifestations behind the negligence of the use of PPE among construction workers, selecting multiple cases is the most suitable to gather data. Multiple cases are employed in order to repeat the same process with the purpose of deriving better results for the study (Yin, 2014). The number of cases was decided based on data saturation. Data saturation is reached when adequate and quality data are avail-able and further coding is no longer feasible to support the study (Fusch and Ness, 2015). Accordingly, two cases were selected to conduct the study. Fusch and Ness (2015) indicated that the unit of analysis can be identified as the main element in the case study design, where the use of PPE among construction workers has become the unit of analysis in this study. Also, cases were selected based on the SMEs since this study was limited to SMEs due to time constraints and limited accessibility (refer Table 2). Accordingly, cross case analysis was conducted by the researcher to draw conclusions at the end of the study.

Table 3: Profile of the Cases

	Case A	**Case B**
Description	9 storied mixed development project, with an apartment and an office building	5 storied building construction project, which is a proposed hostel complex for a private university
Contract Sum	About 520 Million	About 400 Million
Contractor Grading of the Project	C4	C4
Number of Employees	Approximately 40 - 50 employees	Approximately 60 - 70 employees

Semi structured interviews were used in this study for the data collection because it facilitates the researcher to re-question from the interviewee for further clarifications regarding the research area as specified in the study by Fusch and Ness (2015). Accordingly, fourteen respondents were selected representing both managerial and worker level from both cases based on the nature of their works.

Table 4: Profile of the Respondents

Project	**Respondent**	**Management/ Worker**	**Designation/ Nature of Work**	**Work Experience**
CASE A	AM1	Management	Site Engineer	29 years
	AM2	Management	Site safety officer	30 years
	AE1	Worker	Mason	6 years
	AE2	Worker	Carpenter	9 years
	AE3	Worker	Steel Fixer	8 years
	AE4	Worker	Welder	8 years
	AE5	Worker	Plumber	7 years
CASE B	BM1	Management	Admin Officer	8 years
	BM2	Management	Project Manager	12 years
	BE1	Worker	Mason	7 years
	BE2	Worker	Bar bender	10 years
	BE3	Worker	Carpenter	13 years
	BE4	Worker	Rigger	6 years
	BE5	Worker	Plumber	8 years

When the attention is paid to data analysis, content analysis can be identified as the most applicable, flexible as well as commonly used technique, which can be used to analyse textual data (Fusch and Ness, 2015). Hence, code based content analysis was used in order to carry out the data analysis. A code was given for each reason under the individual manifestations by providing a notation as described in below.

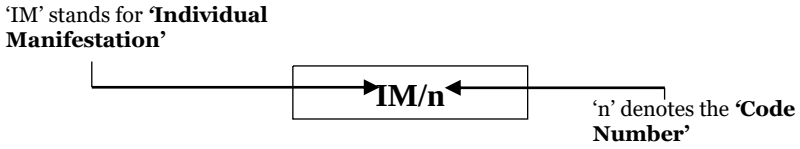

Figure 3: Coding Structure

4. Research Findings and Analysis

Detailed description of cross-case analysis of Case A and B is presented under the subsection of "Reasons under individual manifestations affect for negligence of use of PPE (Section 4.1)" as follows.

4.1. REASONS UNDER INDIVIDUAL MANIFESTATIONS AFFECT FOR NEGLIGENCE OF USE OF PPE

Poor personal attitudes and perceptions have been affecting intensively on the negligent use of PPE by Sri Lankan construction workers. It became apparent from the analysis of findings of both cases that "use of PPE has become a disturbance for the workers (IM/1)". It was because, use of PPE gives them an uncomfortable feeling while working, which delayed the work as mentioned by worker level interviewees. In addition, workers who work at high, face difficulties in handling tools due to wearing of some PPE (i.e. safety helmet) as PPE and other tools get tangled. Subsequently, they tend to ignore the use of PPE, not even realising the importance of them during the works. This poor attitude is

sometimes encouraged by physical inconveniences they have to face due to the poor condition of the PPE. Sweating has become most common issue among these physical inconveniences, which the workers have to face. The situation is getting worst during hot climate periods, which can occur mostly throughout the year in Sri Lanka. This creates hard working environment for the workers, which leads to negligence of use of PPE by them during the works.

Also, workers' attitudes have been either encouraged or discouraged through their experience in the industry. It became clear through the case study findings that "workers who have less experience in the industry mostly tend to neglect the use of PPE (IM/2)". This fact is more common among young demographic. Being less experienced workers, they do not have in-depth understanding on the criticality of safety issues that they exposed to and the importance of use of PPE in mitigating such issues. Thus, they involuntarily tend to neglect the use of PPE during the works. The behaviour of the elderly works on this regard is the flip side of the experience coin. It is because, this finding cannot be corroborated among elderly workers, who have more experience in the field, as per AM2. He derived to a such conclusion through his 30 years' experience in the industry. Elderly workers are being experienced, they are aware of the potential risks that they expose while working. This became further evident through the behaviours of the elderly workers in Case A. Curiously, a contrasting outcome is observed in Case B. As described by BE1, some of the workers in Case B, who are having more experiences are not much concern about use of PPE due to the overconfidence, which they are being more experienced in the industry. Although this finding was substantiated with other workers who are not belong to above categories, they are also sometimes reluctant to use PPE due to physical inconveniences (refer Code IM/1).

Same as to the working experience in the industry, safety attitudes can be encouraged if the workers are having good educational background. It is because, the importance of wearing PPE for safeguarding their life can be easily communicated to them. However, this became a terrible task for managerial and supervisory level personnel due to the "poor education level of the workers (IM/3)". Accordingly, their poor educational level has been led to neglect use of PPE while working. However, such unsafe behaviours can be controlled up to some extent through proper trainings by top management. Unfortunately, such a commitment for the provision of trainings was not identified in both cases. Managerial level personnel justified the fact highlighting that providing training for such uneducated workforce is useless. Also, it incurred unnecessary cost since many of these workers are in temporary basis, as stated by AM1 and BM2. In addition to the poor educational background of workers, negligent use of PPE was also occurred due to the "inadequate knowledge and skills of the workers to use PPE (IM/4)". Workers should have the ability of using PPE in an accurate manner through their knowledge and skills. Unfortunately, such adequate knowledge and skills were not observed in both cases. Poor training facilities for the workers, which was discussed above may be a reason for this situation. As a result, many workers use PPE inaccurately and expose for different physical inconveniences most of the time. This might be one of the reasons for them to perceive use of PPE as a burden (refer Code IM/1).

As per the case study findings, "workers tend to accept any safety risk despite their income level, when the financial issues have become prominent (IM/5)". When the income level of workers is get into account in both cases, it was apparent that majority of these workers were at low income level. Therefore, they have to face many difficulties in their day to day life since they are suffered by many financial issues. This situation had created many negative impacts, which the workers encourage to earn more money at any risk and their safety has become a secondary concern. In a such context, workers ignore the use of PPE most of the time. In addition to the income level of the family, age of the worker can be identified as another demographic factor, which can make a significant impact on the use of PPE by the workers. It was witnessed through the analysis of case study findings that "young workers more reluctant to use PPE rather than old workers (IM/6)". Less experience of the young workers can mainly affect this situation (refer Code IM/2). However, the situation can be contrasted when they have dependents, despite the age. It was because, "workers tend to concern more about their safety when they have more dependents (IM/7)". This perception is more popular

among workers who are married and have more dependents. Personal responsibilities in their life have influenced them to be careful while working.

More importantly, it was apparent through the analysis of findings of Case B that "poor health conditions of the workers have discouraged the use of PPE (IM/8)". As expressed by BE1, construction workers can be identified as hard workers who are working under hard working environment especially with warm climate in most of the time. As a result, different kinds of health issues can occur for them when wearing PPE for a long period of time in such a warm climate. As per the case study findings, 'headache' was identified as the most common health issue among workers. In such a context, workers involuntarily tend to remove PPE. Further, a unique finding, which was emerged only through case study findings is, different inherent lifestyles of the workers have encouraged the negligence of the use of PPE (IM/9). As mentioned by managerial level personnel of both cases, many workers are from different rural areas of the country. Majority of these workers seek temporary job opportunities for a short time period. Such kind of workers are most common in SME construction sites than larger construction sites. These workers are experiencing their inherent lifestyles, which are differentiated with their culture, religion as well as community. Since they have adhered to these inherent lifestyles, they dislike to change them. As a result, unsafe behaviours where the negligence of use of PPE has become very common are highly encouraged.

5. Discussion

The SME construction sector can be identified as one of the main sectors in Sri Lanka, where occupational accidents become more popular (Ofori, 2015). Many reasons can affect this situation and negligent use of PPE by the construction workers is prominent among them, as revealed by Knibbs (2009). Eskandari et al. (2017) identified in their study that workers' unsafe behaviours, which are differentiated by their individual manifestations make a significant impact on the negligence of use of PPE by them. Hence, this study endeavoured to analyse the individual manifestations to unveil the reasons behind the negligence of use of PPE by construction workers in Sri Lanka.

When mapping with literature findings, 06 main reasons under individual manifestations, which encourage the negligent usage of PPE by construction workers were captured. These reasons include 'poor personal attitudes of the workers', 'poor education of the workers', 'poor knowledge and skills of the workers', 'lack of past experiences of the workers', 'age of the workers' and 'poor perceptions of the workers' (refer Table 1). Although these findings were in general, they are almost similar to the Sri Lankan context according to the views of the many respondents (refer Section 4). Apart from those findings, 05 additional reasons were explored through the study. They can be listed as 'considering PPE as a disturbance (IM/1)', 'poor income level of the workers (IM/5)', 'number of dependencies of the workers (IM/7)', 'poor health condition of the workers (IM/8)' and 'different lifestyles of the workers (IM/9)'. These findings have not been discussed in the literature yet. Since majority of the workers in Sri Lankan construction sites have to face many physical inconveniences due to many reasons like poor condition of PPE and weather changes, they consider PPE as a disturbance for their works. This is in line with the findings by Ogundipe, Owolabi and Olanipekun (2018), which states that many workers perceive that PPE is infliction for their works. Further, as revealed through the case study findings, poor income level had created many negative impacts on the use of PPE by the workers because they tend to work at any risk due to the financial issues even though the physical inconveniences are occurred. Although Lombardi et al. (2009) insisted that the age of the workers can either encourage or discourage the use of PPE based on the experience they have, the situation can be differed when they have dependents, despite the age, as indicated by the respondents. Further, respondents revealed that construction workers have to work under the hard working environment most of the time due to the warm climate since Sri Lanka is a tropical country. This results poor health conditions of the workers, which discourage the use of PPE. Moreover, as per the views of the respondents, many workers are from different areas of the country with inherent living patterns, which they have already adhered. These different lifestyles can negatively impact on the use of PPE by them, which was highly evidenced in both cases.

On the whole, 11 reasons under workers' individual manifestations on negligent use of PPE by Sri Lankan construction workers were identified through the empirical findings. As per the case study findings, it was proven that these findings were highly relatable with the current situation of the industry. Thus, aforementioned reasons behind the negligence of use of PPE by the construction workers need to be get into account by the respective industry practitioners in order to make a safe working environment within construction sites in Sri Lanka.

6. Conclusions

When consider about the current situation of the occupational accidents in Sri Lankan SME construction sites, a higher rate of occurring accidents can be identified due to not wearing PPE by the workers. Therefore, reasons, which encourages the negligence of use of PPE by the workers should be properly identified to mitigate those occupational accidents in a significant manner. According to the empirical research findings, it was proven that behavioural changes of the workers as individuals, which relate with their individual manifestations mainly affect for the negligence of use of PPE by them. With regarding these behavioural changes, many causes were identified, which affect for this situation currently in SME construction sites. Accordingly, it is proven that many individual manifestations lead for different reasons, which encourage the negligent use of PPE by the workers. The knowledge generated through the study can be used by the industrial practitioners to make a safe working environment in Sri Lankan construction sites.

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AN INVESTIGATION OF DIFFERENT FORMWORK SYSTEM FOR HIGH RISE BUILDING CONSTRUCTION AND FOR DECISION SUPPORT SYSTEM

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Abstract
The most important aspect of any successful structural construction is the formwork system. Formwork itself defines as the temporary structure into which the concrete placed to obtain its desired shape and gains its weight to withstand against various loading conditions. This paper focuses on the two parts 1. Identified different formwork systems using in Indian construction industry for high-rise building construction and 2. Explanations of the decision support system for formwork system so that a decision-maker decides or makes the right choice for the selection of formwork system. This study employed a literature review approach (journal paper, research paper, technical articles & notes, and white paper). The methodology divided into two parts; firstly, the identification of the formwork systems used in the construction industry and secondly, to study a brief about decision support system and for formwork system by which the ease to make a decision support frame for the formwork system selection. This paper reflects the different formwork system typology used in the construction industry for high-rise buildings. The outcome of this paper helps to establish the baseline to develop decision support for the formwork system selection.

Keywords: *Formwork System, High Rise Building, Decision Support System*

1. Introduction

1.1 FORMWORK SYSTEM

The building construction sector is characterized by an increasing level of mechanization. Formwork is an important constituent of reinforced concrete (RC) structures and reinforced concrete (RC) construction primarily consists of three components; i.e., a. formwork b. reinforcement and c. concrete. Formwork usage has become very extensive in building construction industry, as it offers advantages in terms of quicker execution and better results.

According to Indian Standard, IS: 6461 (Part 5) – 1972, formwork is a complete system of temporary structure built to contain fresh concrete to form it into the required shape and dimensions and to support it until it hardens sufficiently to become self-supporting.

The Indian construction industry has started using some of the excellent latest technologies. Several formwork systems are in use at different places in the world; eventually, the systems, which reasonably economically ease for operation with semi-skilled labor, are more useful in India.

According to the Ministry of Housing and Urban Poverty Alleviation (MoHUPA, 2012), there was a shortage of 18.78 million housing units in urban India. Nearly 95% of this shortfall was in Economically Weaker Sections (EWS) and Low Income Group (LIG) housing etc. To overcome the shortage of housing units the Ministry of Housing and Urban Poverty Alleviation (MoHUPA) has launched Pradhan Mantri Awas Yojana (PMAY) “Housing for All” (Urban) Mission on 25th June 2015. Based on the estimated shortage of houses, about 2 crore houses are required to be constructed in seven years. To achieve this goal, a multi-pronged approach is necessary including the use of emerging alternate building materials and technologies and especially to formwork systems. A large number of high-rise building construction projects are being undertaken in the residential sector in India (Basu and Jha, 2016).

According to National Institution for Transforming India (NITI) Aayog – Strategy for New India @75, 2018 report, the Ministry of Rural Development (MoRD) and Ministry of Housing and Urban Affairs

(MoHUA) recently estimates a housing shortage of nearly 3crore units in rural areas and 1.2crore units in urban areas. Therefore, to achieve the goal of the construction of total 4.2crore housing units in India the formwork system plays an important role for high-rise building construction projects but the problem is still with the construction industry that by which formwork typology the construction of high-rise building needs to be constructed and due to lack of standards and guidelines so the decision cannot be taken into consideration.

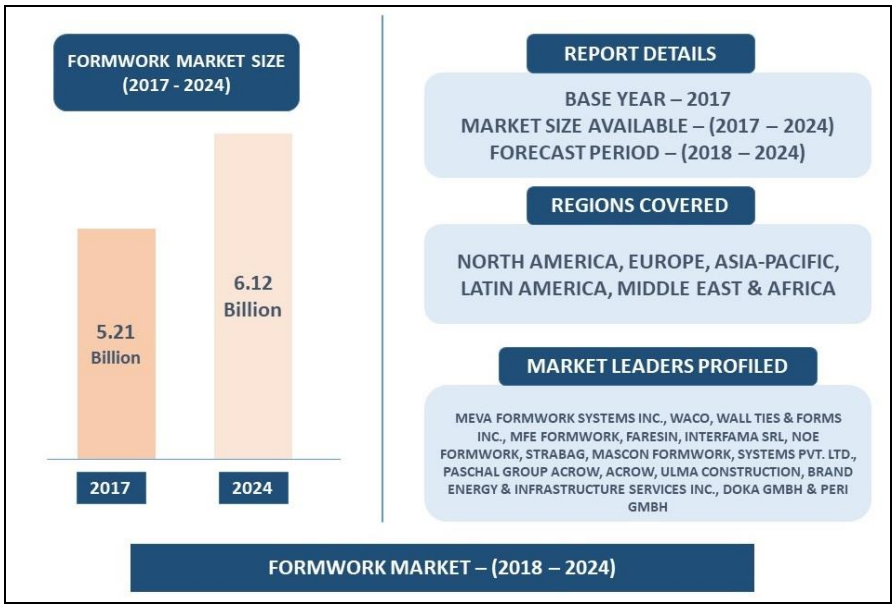

Figure 1, Globally formwork market (2017-2024)
(Source: Formwork Market, Industry Growth, Market Size, Share, Forecast 2018 - 2024)

The various decisions were taken for the selection of formwork system and typically for the identification of the formwork system to be used in the construction industry.

1.2 DECISION SUPPORT SYSTEM

The concept of a Decision Support System (DSS), though quite widely used and developed in many research, is by no means well defined. Decision Support Systems (DSS) represent a concept of the role of computers within the decision-making process. It contrasts to decision automation systems that replace humans in repetitive decisions because these decision problems are either too tedious or require very fast reaction time or very high precision.

McCowan and Mohamed (2007) presented that the decision support processes have been widely used to assist managers to determine the most appropriate paths to take. However, despite of all semantic problems it is possible to list several basic characteristics of Decision Support Systems (DSS). Parker and Al-Utabi (1986), Keen and Scott-Morton (1978) and Sprague and Carlson (1982) stated the following characteristics as:

a. DSS assist decision makers in their decision processes in semi-structured & unstructured tasks;
b. DSS support and enhance rather than replace managerial judgment;
c. DSS improve the effectiveness of decision making rather than its efficiency;
d. DSS attempt to combine the use of models or analytical techniques with traditional data access and retrieval functions;

e. DSS specifically focus on features which make them easy to use by users who have less knowledge of computer in an interactive mode;
f. DSS emphasize flexibility and adaptability to accommodate changes in the environment and the decision making approach of the user.

2. Problem Statement And Literature Review

The poor state of technology (formwork system) opted by the construction sector for high-rise building adversely affects the performance of the complete structure in terms of the poor quality of the structure or building, construction cost is high, the completion time of the project is more, low labor productivity, low-grade raw materials, failure of structure, etc.

According to Building Materials & Technology Promotion Council (BMTPC - White Paper, 2015), some of the technologies have been developed and are successfully being used in other countries and are trying to implement in the Indian construction industry especially for a high-rise building. Building Materials & Technology Promotion Council (BMTPC) have identified, evaluated, and promoted sixteen (16) new emerging technologies under PMAY (U), as mentioned in table 1. However, the research work based on the formwork system, and then only formwork system technology needs to be taken into consideration.

Table 1: Emerging construction systems identified by BMTPC

SYSTEM	TYPE	TECHNOLOGY
Formwork System	Engineered Formwork System	Monolithic concrete construction system using aluminum, plastic-aluminum or composite formwork
		Modular tunnel form
	Stay-in-place formwork system	Sismo building technology
		Insulating concrete forms
		Monolithic insulated concrete system
		Structural stay-in-place formwork system (Coffor)
		Lost-in-place formwork system (Plaswall panel system)
		Plasmolite wall panels

Formwork represents a significant part of any concrete construction project and accounts for 40-60% of the cost of the concrete skeleton and about 10% of the total construction cost (Hanna, et al., 1992; Shin, et al., 2008; Shin, et al., 2012; Shin, Y., 2011; Eder, et al., 2016).

Selection of an appropriate formwork system is an extremely crucial and complex factor for the successful completion of any residential (high-rise building) construction project (Basu and Jha, 2016; Eder, et. al., 2016). Selection of the optimum formwork system requires years of experience in formwork analysis and design but before selection of the formwork system for high-rise building need to investigate the formwork system typologies.

An extensive study has been carried out for the decision support system and formwork system to overcome the situation of choosing the right formwork system for high-rise building construction. As decision support system itself is complex and perplexed, therefore, many researchers have developed the decision support system as in terms of using the optimization methods/tool or by using the multi-criteria decision-making method (MCDM) between two to three formwork systems and choose for the best and especially conventional formwork system with the mechanized formwork system. None of the studies has the formwork system typologies based classification for high-rise building construction. Hence, the need of a decision support system is crucial and essential for the formwork system for enduring decisions.

According to Sprague & Watson, (1996) presented a conceptual model are critical to understand the newly complex DSS. The author categorized the DSS into interactive computer based system that helps to solve structured, semi – structured, and unstructured model/framework for decision-making.

Randall E. Louw (2002), the author explain & presented the detailed about DSS history, category. The author introduced the uses & requirements of information at different managerial level because DSS helps to improve management control by considering primary task as –

1. Allocation of resources to specific activities.
2. The expenditure of resources and the expected achievement goals and objectives will help to prepare the budget.
3. Observation of results achieved in return for resources used.
4. Evaluation of results
5. Make the modification in above for tasks

At last, the author concluded that DSS could be extremely beneficial to any organization's overall performance. DSS can also be the cause of great confusion, misperception & even inaccurate analysis as these systems are not designed to eliminate bad decision.

Safa, H. et. al. (2016), the authors contributes to the development of unavailable model for facilitating & validating formwork decision, which based on the advantages, and disadvantages of the different forming systems. The authors identifies 9 types of forming method & system i.e., stick-built, split forms, molds (for architectural elements), paving & towers (horizontal & vertical), aluminum frame & panel section, modular & quick connect, insulating concrete forms (ICF), reusable wood section (elevator core), but the focused only on 5 classification. The author's model based on the Hanna upgrade theory, which was taken by Construction Industry Institute (CII). It is knowledge expert DSS. The author compares the pros and cons to identify the decision for formwork. The author concluded that to assist decision makers, the decision model based on the advantages & disadvantages of the latest formwork systems versus old/traditional formwork system and suggested the latest/modular system, the best choice or decision in application with the high amount of repetitions.

Shin, Y., et. al. (2012), the authors proposed a formwork selection model based on boosted decision trees to assist the practitioner's decision-making; the selection has depended mainly on the subjective and intuitive opinions of practitioners with restricted experience. The author uses three different model methods as ANN, DT, BDT to select the best decision for the formwork method such as wood form, con-panel, aluminum forms, table form, sky-deck for tall buildings. The case studies are taken in to consideration, which was restricted to Korea only. For data collection, the authors took data from 15 major general contractors for 75 tall building construction projects in large cities of Korea. The formwork selection model based on BDT tested by applying it to real cases of tall building projects. Thus the results shows from the five-folds of formwork and cross validation with 20-21 different test datasets using ANN, DT, BDT. The result of the three different models for either formwork selection model showed that the BDT model is more accurate that the ANN model or the DT model. Lastly, the authors proposed a formwork selection model based on the BDT to assist practitioners' decision-making in selecting a formwork method suitable for construction site condition in tall building construction projects.

Hanna et al. (1992) proposed using an expert system for the selection of vertical and horizontal formwork systems. The knowledge base required by the expert system was built based on literature and information gathered from North American experts. The expert system was tested on hypothetical projects.

3. Research Methodology

A simple research methodology was implemented which was divided into two phases. In phase – I of research methodology focus on the identification of the formwork system and its typology used for high-rise building construction and in phase – II of research methodology focuses on the study of decision support system for formwork system.

4. Scope And Limitation

The scope of this study is limited to the identification of the formwork system and its typology. Formwork system typology is further classified as repetitive formwork system typology; non-repetitive formwork system typology. These classifications will further classify based on the factor for the formwork system selection.

An introduction of decision support system (DSS) taken into consideration for the formwork system and it is taken in the form of DSS definitions, DSS for the different formwork system. However, formwork system typology is not only the responsible parameter for making a decision support system; the factors responsible for formwork system selection are not identified in this study and can be taken for further research.

5. Research Finding And Discussion

To identify the formwork typologies, the total 59 (International & Indian journal, research papers, and technical article & notes) were investigated and presented in the below table 2.

Table 2: The number of identified Formwork Typology in the respective years (Source: Author)

Sr. No.	Year	Formwork Typology	No of Formwork Typology identified w.r.t no. of years
1.	2016	Stick-built Formwork	1
2.	2013, 2016, 2017	Modular Formwork	4
3.	2005, 2016, 2018	Prefabricated Formwork	3
4.	2016, 2019	Insulating Concrete Formwork	2
5.	2016	3D Printing Formwork	1
6.	2005, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	Aluminum Formwork	21
7.	2011, 2012	Sky-deck Formwork	3
8.	1992, 2000, 2005, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	Wood/Timber Formwork	31
9.	2016, 2018	Modern Formwork	3
10.	2005, 2013, 2014, 2015, 2016, 2017	Steel Formwork	13
11.	2013, 2014, 2015, 2016, 2017	Plastic Formwork	7
12.	2016, 2017	Traditional Formwork	3
13.	2017	Horizontal Formwork	1
14.	2005, 2012	Vertical Formwork	2
15.	2005, 2011, 2012, 2017, 2018, 2019	Table/Flying Formwork	8
16.	2010, 2013, 2016	Climbing Formwork	3

17.	2015, 2017	Tunnel Formwork	3
18.	1992, 2015, 2019	Jump Formwork	3
19.	1992, 2005, 2013, 2015, 2018, 2019	Slip Formwork	6
20.	2009, 2011, 2016	Fabric Formwork	6
21.	2016	Coffer Formwork	1
22.	2011	Flexible Formwork	1
23.	2017	Controlled Formwork	1
24.	2015, 2016	Pneumatic Formwork	2
25.	2018	Hanging Formwork	1
26.	1992	Self-raising Formwork	1
27.	1992, 2004, 2005	Ganged Formwork	3
28.	1992	Column/Wall Formwork	1
29.	1994, 1999, 2011, 2015	Slab Formwork	4
Noted: There is the repetition of years, so taken as the single year. The colour filled block is taken for the further research and not considering any other formwork system for this research.			

According to table 2; the highest number of formwork typology was identified as 31 and the lowest number as 1 in the given respective years. The highest number is of wood/timber formwork system, as the conventional formwork system was an ancient type of formwork system were used in the construction of any structure and the lowest number 1 is for few formwork systems and they are not commonly used for the construction of high-rise building construction. Further the formwork typologies were narrow down to the limited number and then to the repetitive and non-repetitive typology as shown in figure 2 and figure 3.

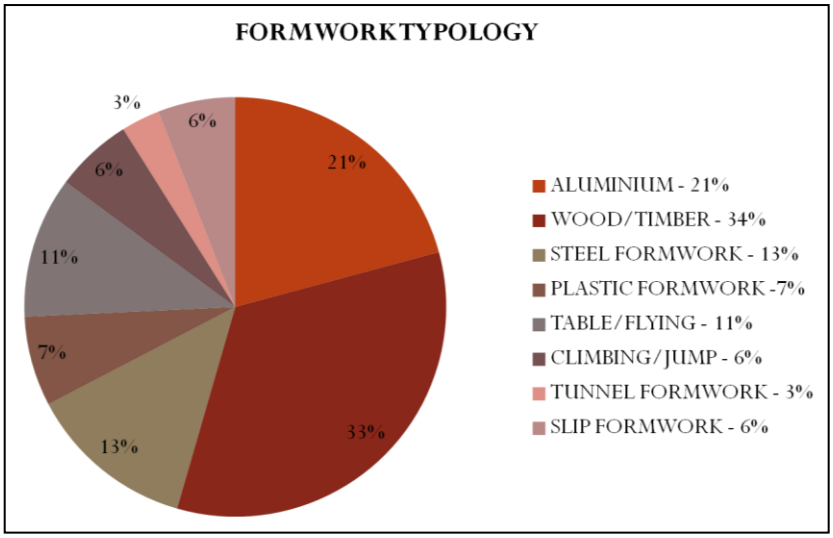

Figure 2, Identified Formwork Typology which are highly used in construction

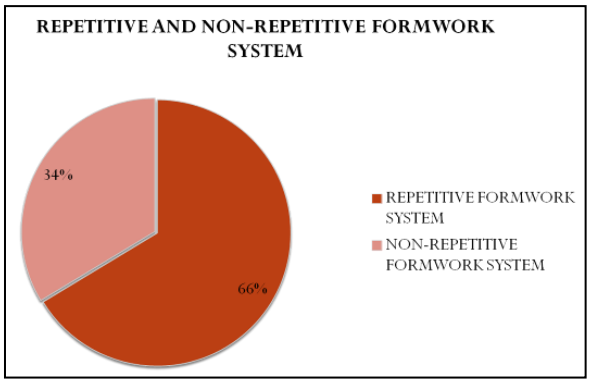

Figure 3, Categorized into repetitive and non-repetitive formwork system

6. Conclusion

With the increasing pace of construction industry development in the country, mostly high-rise building is being constructed globally. Nevertheless, according to table 2, it was concluded that the conventional formwork system is more commonly used for the construction of high-rise buildings. The choice and arrangement of utilizing formwork is highly depended on individual site/project environment and several factors.

From table 2, the eight-formwork typology needs to look forward for this research. In figure 2, the selected or identified formwork typology as it is shown in the format of pie chart. In figure 3, again it is classified as repetitive and non-repetitive formwork system. The repetitive formwork systems are that type of formwork system, which can be used repeatedly with some number of extents for construction, i.e., nature of repeating. The non-repetitive formwork systems are that type of formwork system, which cannot be used repeatedly for construction, i.e., nature of non-repeating.

However, from figure 2, concluded that the wood/timber formwork system cannot be used repeatedly, thus considering in non-repetitive formwork system as shown in figure 3.

Another valid reason found from the literature review, there is lack of the system or framework that directly makes the right selection of formwork for the right type of building typology to be constructed which will fulfill the need of the stakeholders to make the right decision for selecting right formwork and right building typology. Mostly noticed from literature review, the contractors provide those formwork typologies, which are available with them.

Decision Support System, plays an important role in making the decision in any organization. Focused on the decision support system for formwork, which mainly consists of two or three formwork typology or took as general for the decision to be made by few method/tool such as ANN, BT, etc.

However, around 5.03 percent of India's population is still houseless (2001 Census) (including 4.03 percent institutional population). The three major bottlenecks in the construction of high-rise buildings are: (a) lack of knowhow on making disaster-resistant housing, (b) lack of expertise for effectively using local material in house construction, and (c) inadequate finances. Other bottlenecks are (d) lack of knowledge and experience in the latest formwork system technologies, (e) shortage of skilled workforce, (f) high machinery cost, (g) lack of training sessions, etc. The State Governments in association with the Central Government have undertaken several high-rise building projects to provide houses to the needy because the selection of an appropriate formwork system is an extremely crucial factor for the successful completion of any high-rise building construction project.

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BENEFITS OF LEED CERTIFICATION IN TERMS OF WATER EFFICIENCY IN HOTEL INDUSTRY: A LITERATURE REVIEW

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Abstract
Water is the world's most precious resource, vital for humanity and the remainder of the world. Due to the incredible water consumption in the hotel industry, hoteliers are required to pay more concern on water saving. The water consumption of the hotel is directly influenced by existing water efficiency practices. Green Building Rating Systems (GBRS) provides a structure or collections of metrics to determine the level of water efficiency achievable by a building. Therefore, the purpose of the study is to identify how LEED certification guide hoteliers to achieve water efficiency. The literature synthesis highlights the water efficiency practices, which should be followed by the hoteliers in order to obtain LEED certification. Accordingly, it guides hoteliers to achieve water efficiency under four categories such as outdoor water usage reduction, indoor water usage reduction, cooling tower water usage reduction and water metring. Further, the study identifies the performance gaps between LEED certified hotels and non-LEED certified hotels by highlighting the water efficiency practices adapted by worldwide LEED certified hotels. Moreover, the study revealed that LEED is the most adaptable system used in Sri Lanka among other green rating systems due to its glob-al recognition. The findings of this study could be used by hoteliers as a basis in understanding the available water efficiency practices and measures for the hotels that could be utilised in achieving water efficiency.

Keywords: *Water Efficiency, Green Building Rating System (GBRS), Leadership in Energy and Environment Design (LEED)*

1. Introduction

Water is the most valuable global commodity, which provides multiple benefits for people (White et al., 2010). The hotel industry consumes substantial amounts of water from complete water use because Wong, 2014). The water consumption of the hotel depends not only on the nature, quality and size of the hotel but also on the facilities given, the weather and current procedures in the hotel for water conservation (Erdogan & Baris, 2007). Pratt (2014) stated that GBRS provide frameworks or sets of metrics to assess the water efficiency level a construction can achieve. There are several green ranking systems used in Sri Lanka and LEED is the most versatile system due to its global recognition (Rodrigo & Jayarathne, 2012). According to Walsman (2014), LEED certification helps to cut operating costs and improve the revenues of the hotel. The sum of the savings obtained by achieving LEED certification caused to increase the annual revenue (Ribero, Garzon, Alvarado, & Gasch, 2016). Also, LEED certified hotels are more attractive to hoteliers because of water saving and energy saving through mechanisms and better environment (NICHOLS, 2017). However, poor performance of LEED certified building also can be identified when compared to non-LEED certified building are also evident due to the of misuse of available conservation systems accredited by the LEED certification (Orr, 2014). Further the author stated that LEED buildings perform no better, and in fact perform worse, than non-LEED buildings.

Several researches had been carried out regarding water saving strategies in the hotel industry, water efficiency in green building and non-green buildings in the apparel sector. Those studies discovered that general practices used by LEED and Non-LEED hoteliers to manage their water consumption. Yet, there is a lack of concern on the comparative study of water efficiency practices regarding the LEED certified hotel building and Non-LEED certified hotel building in Sri Lanka. Therefore, the problem emerges from a comparison between LEED certified and Non-LEED certified hotels water efficiency practices to identify the benefits of LEED certification.

2. Methodology

A systematic analysis of literature expedites the researcher to enhance the research base by consolidating the existing knowledge from around the study area. Kumar (2011) declared that a comprehensive literature synthesis helps to establish the theoretical roots of the study, clarify the ideas and develop the research journey. Therefore, the researcher can identify the link between what the researcher is proposing to examine and what has already been studied.

Hence, a rigorous theoretical study was conducted to investigate the diverse water efficiency criteria of LEED certification and established the advantages of LEED certification for the hotel industry in Sri Lanka by referring research articles, conference proceedings, newspaper articles, thesis and respective websites. Among the available search engines, 'Google Scholar', 'Scopus', 'Emerald', and 'Science direct' were selected for this study, as these domains have been widely used in similar reviews (e.g. Yang et al., 2009). Furthermore, the water efficiency practices used by the LEED certified hotels were identified through the literature synthesis. Compiling the extensive literature findings, a conceptual framework was developed to identify the water efficiency requirements of LEED certification and how the LEED certification is involving to enhance the water efficiency in the hotel industry.

3. Water efficiency in hotel industry

Hoteliers can save money and increase their profits by taking simple measures to save water and energy in the hotel premises (Fountain, 2015). The water consumption of a hotel is a different hotel to hotel (NYC Environmental Protection, 2018). In order to achieve water efficiency in the hotel, there are several water conservation strategies can be followed. The Table 1 shows the water efficient strategies used by the hotel.

Table 1- Strategies to Achieve Water Efficiency in Hotel Building

Water Efficiency Strategies	Description	Reference
Water Management Plan	This is a water-saving action program that provides details on current water usage and describes water efficiency improvement procedures, water conservation strategies, and water conservation targets.	(US Department of Energy, 2019)
Green Building Rating System	Water efficiency is one of the key parameter which should be full-filled by the building which is planning to get the Green Rating certification. Therefore, it encourages people to enhance water efficiency in the building.	(Waidyasekara and Silva, 2013)
Water Hierarchy	It performs as a guide to changes the water efficiency in qualitatively as well as quantitatively. It is a guideline for qualitative and quantitative prioritization of process changes. The WMH consists of five levels, namely (1) source elimination, (2) source reduction, (3) direct reuse/outsourcing of external water, (4) regeneration, and (5) use of fresh water.	(Wan Alwi *et al.*, 2014)
Water Metering	Water metering provides the operations and maintenance transparency needed to manage water resources more efficiently. The information provided by metering of water can encourage behavioural reductions in consumption by increasing consumer knowledge about their resource use.	(Berger *et al.*, 2016)
Water Audits	A water audit is a survey that all water uses or transports equipment, plumbing, equipment and practices in a business or manufacturing facility to determine the current water uses, losses and conservation practices and recommend improvements. It serves as a starting point to identify losses and implement useful practices in water efficiency.	(New Hampshire Environmental Service, 2013)
Faucet Aerators	A faucet aerator that has low-flow and high-efficiency reduce the water usage by 4%. Making the switch can potentially save more than 500 gallons of water each year.	(Preston, 2019)
Low Flow Tap	Low-flow taps operate by adding air into the flow of water. By using this low flow tap, it provides the feeling of complete water flow, even though the amount of water is significantly lowered.	(Australian Government, 2018)

Adapted from: (US Department of Energy, 2019; Waidyasekara & Silva, 2013; Wan Alwi et al., 2014; Berger et al., 2016; New Hampshire Environmental Service, 2013)

4. Green Building Rating Systems

GBRS are the certification systems that concentrate on the project as a whole beyond the product (Vierra, 2014). Doan et al. (2017), identified various types of globally recognised GBRS to assess the building efficiency. GBRS is intended to determine and assess building efficiency from planning, design, construction and activities (Sachin & Jha, 2012). In Sri Lanka, mainly adopted systems are LEED certification and Green SL certification.

4.1. LEED

As per the U.S. Green Building Council (2017), LEED or Leadership in Energy and Environmental Design is the most universally used green ranking system in the world. Moreover, the authors emphasised that the LEED certification system evaluate six aspects; Sustainable sites, Water efficiency, Energy efficiency, Material, Indoor Environment Quality and Innovations, when giving the certification for buildings.

4.2 GREEN SL

Green SL rating system was initiated by Green Building Council Sri Lanka based on the LEED certification (Kumanayake, Luo and Paulusz, 2018). In addition, the researcher noted that the Green SL rating system for existing buildings is a collection of performance standards for accrediting the operation and maintenance of commercial or industrial buildings.

5. Different Water Efficiency Requirements of LEED Certification

The water efficiency classification under the LEED certification focuses specifically on water use reduction, water efficient landscaping and innovative wastewater technologies (Gurgun, Komurlu and Arditi, 2013). According to the US Green Building Council (2019), the requirements should be full filled to get the LEED certification can be described as follows.

5.1 PREREQUISITES

These requirements are something that is necessary to an end or to the carrying out of a function. Therefore, to get the LEED certification, the building should be achieved following requirements earlier. It also add value when calculating the credits under the LEED certification.

5.1.1 Outdoor Water Use Reduction

This requirement describe that how to build up the facility to reduce the future (operation Phase) outdoor water consumption. According to the US Green Building Council (2019), the facility should be fulfilled the reduction of outdoor water usage through one of the following options.

Option 1: No irrigation required

Beyond a fixed establishment duration of two years, the landscape does not require a permanent irrigation system.

Option 2: Reduced irrigation

Landscape water use for peak irrigation at the site may be reduced by at least 30% from the baseline measurement. The reduction of water must be done by plant species and the effectiveness of the

irrigation system. Two additional points can be earned by reducing the prerequisite water requirement. The point allocation for additional outdoor water conservation can be shown as follows.

Table 5: Points for Reducing Irrigation Water

Percentage reduction from baseline	Points
50%	1
100%	2

(Source: US Green Building Council, 2019)

5.1.2 Indoor Water Use Reduction

The aim of this prerequisite is reducing the indoor water consumption before the operation of the facility. All recently installed washrooms, urinals, private wash faucets and showerheads should be labelled with Sense water (SLOANE Global Holdings, 2016). The basic water consumption of fixtures and fittings can be shown in Table 3 below.

Table 6: Baseline Water Consumption of Fixtures and Fittings

Commercial Fixtures, Fittings, and Appliances	Current Baseline (SI units)
Water closets (toilets)	6 liters per flush (lpf)
Urinal	3.8 Liters per Flush (lpf)
Public lavatory (restroom) faucet	1.9 Liters per Minute (lpm) at 415 kPa, all others except private applications
Private lavatory faucet	8.3 Liters per Minute (lpm) at 415 kPa
Kitchen faucet (excluding faucets used exclusively for filling operations)	8.3 lpm at 415 kPa
Showerhead	9.5 lpm at 550 kPa per shower stall

(Source: US Green Building Council, 2019)

Moreover, the US Green Building Council emphasised that water consuming appliances, equipment, and processes must meet the requirements listed in the following Table 4.

Table 7: Standards for Appliances

Appliance	Type	Requirement (SI units)
Dishwasher	Under counter	≤ 6.0 liters/rack
	Stationary, single tank, door	≤ 5.3 liters/rack
	Single tank, conveyor	≤ 3.8 liters/rack
	Multiple tank, conveyor	≤ 3.4liters/rack
	Flight machine	≤ 680 liters/hour
Food steamer	Batch	≤ 23 liters/hour/pan
	Cook-to-order	≤ 38 liters/hour/pan
Combination oven	Countertop or stand	≤ 13 liters/hour/pan
	Roll-in	≤ 13 liters/hour/pan

(Source: US Green Building Council, 2019)

5.1.3 Building Level Water Metering

As a precondition for receiving water efficiency points, LEED has introduced a building level water metering standard (Harbour, 2016). According to the US Green Building Council (2019), permanent water meter installation will calculate the maximum use of the building's potable water and associated grounds. Monthly or annual meter readings must be collected manually or automatically. It also notes that this commitment will continue for a period of five years or until the building changes ownership or the lessor.

5.2 ADDITIONAL REQUISITES

Once the facility has fulfilled all the preconditions, there are four places where additional LEED credit points can be received by the facility.

5.2.1 Outdoor Water Usage

Eliminating the need for an outdoor irrigation system fully or increasing the need for landscape water by at least 50 % will receive up to 2 points (SLOANE Global Holdings, 2016).The 50 % reduction of water can be accomplished from the approximate base point for the site's peak irrigation month by selecting plant species and active irrigation systems (US Green Building Council, 2019). In addition, the article highlighted that any combination of capacity, alternative water sources and intelligent scheduling technologies could achieve additional reductions above 30%.

5.2.2 Indoor Water Usage

A building can gain up to six points for LEED certification by using high-efficiency components and alternative water resources to go beyond the precondition (Southerland, 2015). In addition, the author clarified that water recycling supports the pilot credit for sustainable waste water management, which aims to reduce waste water use by 50% from a baseline. As stated in US Green Building Council (2019), required water reduction percentages and its credit allocation can be shown following Table 5.

Table 8: Points for Reducing Water Use

Percentage reduction	**Points (CI Hospitality Industry)**
25%	2
30%	4
35%	6
40%	8
45%	10
50%	11

(Source: US Green Building Council, 2019)

5.2.3 Cooling Tower Water Use

The main aim is to maintain the water requirement of the cooling tower while regulating bacteria, oxidation and scale in the condenser water system (US Green Building Council, 2019). Evaporative condensers that are more energy efficient than traditional condensing systems due to evaporative systems can reduce air temperature more quickly and do not lose air humidity (Western Cooling Efficiency Center of the University of California Davis, 2011). Completing this sort of evaporative condenser would allow up to two points for a project (Southerland, 2015). For cooling towers and evaporative condensers, one time potable water study can be undertaken to optimize cooling tower cycles. The points are allocated according to the number of cooling tower cycles and following Table 6 describes that the credit allocation.

Table 9: Points for Cooling Tower Cycles

Cooling tower cycles	Points
Maximum number of cycles reached without reaching any rate of filtration or affecting condenser water system operation (up to maximum of 10 cycles)	1
Achieve a minimum of 10 cycles by increasing the level of treatment in condenser or make-up water or achieve the number of cycles for 1 point and use a minimum 20% recycled non potable water	2

(Source: US Green Building Council, 2019)

5.2.4 Water Metering

Water metering is a new LEED version 4 credit that mainly focuses on water sub metering in the building (Western Cooling Efficiency Center of the University of California Davis, 2011). As stated in US Green Building Council (2019), two or more sub-systems such as irrigation, indoor plumbing and fittings, hot water, boilers, waste water or other process water should be installed in the sub-metering system.

6. Water Efficient Practices in LEED Certified Hotels

According to the Ahn and Pearce (2013) case study, two LEED platinum certified hotels in the United States were analysed to identify the water efficient strategies. The researchers further indicated that, in order to improve water efficiency both hotels have installed highly efficient water-saving appliances and fittings, including highly efficient water closets, dual flush toilets, waterless urinals and low-flow showers.

The most common ways of minimizing water consumption in the hotel industry are to replace current appliances with water-efficient elements, like cleaning facilities, toilets, showers and faucets (Bruns-Smith *et al.*, 2015). In addition, the study showed that the installation of low-flow showerheads and air-conditioned roofs saved $1.50 per room per month for one hotel and saved 180,000 gallons of water per year using water-efficient toilets. Besides that, the hotel use grey water recycling system, water saving notices in the bathroom and a localised irrigation system to reduce water consumption (Gonzalez and Leon, 2001). ITC Grand Chola Hotel in Chennai is a LEED platinum rated hotel and it is the world's largest LEED Platinum rated Green Hotel (Tuppen, 2012). As stated in the article, the hotel is adapting following water conservation methods.

- Green roofs and water harvesting structures are used to collect storm water.
- All the irrigation activities, flushing and cooling tower operation is fulfilled using treated water.
- Using water efficient fixtures, fittings and appliances, water usage is reduced by 35% compared to conventional usage
- Choose plants that consume low water, while trees plant to reduce the loss of evaporation and thus reduce water consumption
- Use drip irrigation and timer based controls to operate the irrigation valves and prevent wastage of water
- The water from the last wash is used in the laundry to pre-wash the second cycle
- The use of environmentally friendly low acidic washing fluids helps to reduce running time and saves water

The Hyatt hotel, which has become the first LEED-certified hotel in Seattle by receiving the LEED Silver certification, achieved a 32% reduction in water use by installing low-flow showerheads, washstands and water closets, along with dual-flow toilets and other water-saving innovations (Chikushi, 2009). Cinnamon Bey Beruwala became Sri Lanka's first hotel to obtain LEED Gold certification after observing and meeting the requirements of all the sustainable standards required by a business entity (Senanayake, 2014). According to the writer, he clarified that revolutionary water-efficient landscaping system reduced the use of drinking water in the irrigation system by 100% and

water management techniques reduced the use of water by 65,62% compared to conventional buildings.

7. Benefits of LEED Certification for Hotel Industry

LEED assesses the performance of the building throughout its life cycle and it is the most preferable globally accepted green rating system, which can save energy by 25%-30% (Moussa and Farag, 2017). According to Johnston and Breech (2011), the main reason for most hoteliers seek to gain LEED because of its operational efficiencies and revenue increase. Moreover, the authors emphasised that innumerable advantages associated with LEED certified building and those are listed below.

- Lower operating cost

Through energy efficiency and water efficiency, hoteliers can reduce utility bills. For example, the Proximity Hotel in Greensboro which is certified under LEED certification reduces the utility bill by achieving 39.2 % less energy and 33.5 % less water.

- Increased property value

LEED certification adds value to the property and it has a higher market value than a conventional building.

- Healthier and safer for occupants

Under the LEED certification, the building should consider the Indoor Environment Quality, lighting, and it gives a better working environment for employees.

- Certified recognition of green practices

LEED gives the physical proof of the values of the organization that owns and occupies the building. It is a market differentiator and it caused to attract the customers to the hotels.

As stated by the Verma and Walsman (2014), the LEED certified hotels obtained superior financial performance as compared to Non- LEED certified hotels. According to Leon (2016), LEED certification increase the satisfaction of guests in the hotel by giving a comfortable environment. Moreover, the LEED certification system is a transformative tool that positively impacts the triple bottom line of the hotel such as people, planet and profit (Lundin, 2016).

8. Conceptual Framework

Based on the literature review findings the study developed a conceptual framework to provide an overview on the impact of LEED certification in water efficiency. The developed framework is presented in Figure 2.6. It illustrates the water efficiency practices in the hotel industry, while identifying the water efficiency requirements needed to achieve when getting the LEED certification. The water efficiency requirements are categorised into pre-requisites and additional requisites. Pre-requisites are presented in a purple colour box and additional requisites are summarised in a blue colour table. The aim of this study is identifying water efficiency requirements under LEED certification and establish the benefits of LEED for hotel industry, which is shown in yellow colour box. The literature findings identified the overall benefits of LEED certification, but it is not specifically identified the benefits of LEED certification specifically for water efficiency. It will be covered in future studies.

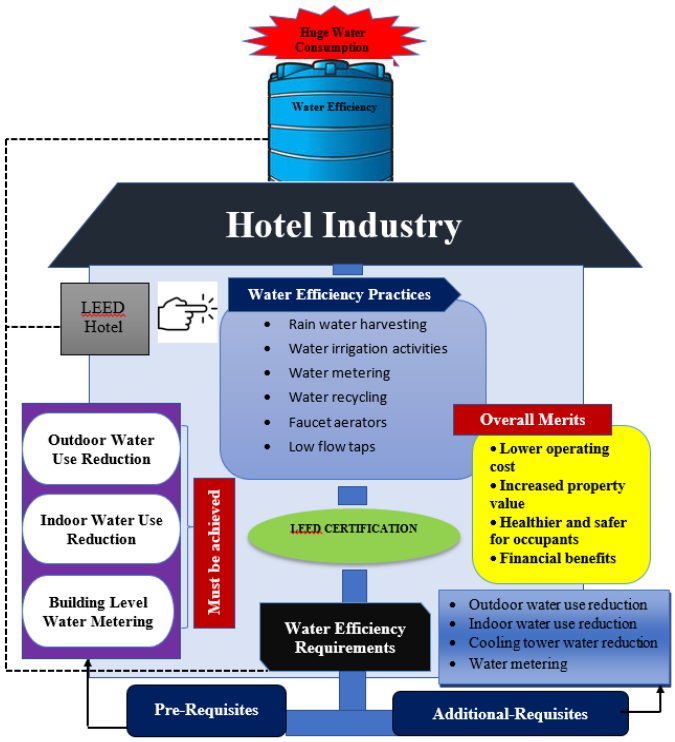

Figure 1- Conceptual Framework

9. Conclusions and Recommendations

There are several green building rating systems, which are focused on water efficiency in a building. Among those green building rating systems, LEED certification is the globally applicable certification system in the hotel industry. The LEED certification system evaluates six aspects; sustainable sites, water efficiency, energy efficiency, material, indoor environment quality and innovations when giving the certification for buildings. LEED is the most suitable rating system, which evaluates the water efficiency category because it focuses on the prerequisites of water efficiency before doing the reductions. A minimum of 11 points can be received in the LEED certification under the water efficiency category, which mainly focuses on water use reduction, water efficient landscaping and innovative waste water technologies. According to the progress of those sections, the points are allocated under water efficiency category.

Being a LEED certified hotel is not only beneficial for water efficiency, but for every aspects in the hotel. LEED certification assesses the performance of the building throughout its life cycle and it is the most preferable globally accepted green rating system, which save energy, water and operational cost. Therefore, most hoteliers seek to gain LEED because of its operational efficiencies and revenue increasement.

Through the identified water efficiency requirements under the LEED certification, this study discovered the benefits of LEED certification for water efficiency. Apart from that, the practical usage of those water efficiency requirements were identified by studying the worldwide case studies. Yet, the research findings were completely based on a thorough analysis of literature which leads a way forward to continue the study to explore the benefits of LEED for water efficiency and practicality of the LEED water efficiency requirements in Sri Lankan hotel industry.

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ASSESSING FACTORS AFFECTING UNIVERSITY STUDENTS' PREFERENCE OF WALKING; COMPARING UNIVERSITY OF MORATUWA & UNIVERSITY OF SRI JAYEWARDENEPURA

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Abstract
This research has been investigated factors affecting students' preference of walking comparing two universities which have distinct characteristics regarding the students' preference of walking. First developed framework including factors affecting for walking which have been found through reviewing past research studies. The framework has included three main features: Functionality, Safety and Aesthetic. Under the each feature, a set of elements have studied. Distance and duration elements and safety feature are significant for the decision of walking of university students over the other transportation modes available. Contribution of road conditions such as pavement availability, aesthetic aspects, shading trees, pollution and cleanliness and traffic volume and speed are not highly significant to decide student walking although it highly matters for decide leisure walking. Therefore this research has been revealed the importance of assessing the factors which contribute the decision of walking of university students. This will be helpful to decide future strategies for improve walking.

***Keywords**: Walking Preference; University; Functional; Safety; Aesthetic*

1. Introduction

Countries have been begun as small walk-able cities and grown through the help of the different mode of transportation over years. The typical modes of passenger transportation found in most cities today can be generally categorized into walking, cycling, public transportation, and the private automobile. Usage of the private vehicle has been rapidly growing especially in urban areas of developing countries that have led to many environmental and socio-economic issues such as congestion, high fuel consumption and air pollution. Traffic congestion and delays continue to be the problem in mega, large and even in small cities, due to the excessive volume of private car; an important strategy to reduce the use of the private car is by offering high quality public transport services and by encouraging pedestrian mobility. Supporting pedestrian mobility is a key factor in sustainable urban development however peoples' preference; willingness to choose the walking is different in countries, regions, personnel behaviors and due to many other reasons.

Pedestrian mobility is generally important at the urban scale, but also inside a large part of an urban area that is a university campus. Eboli et al (2013). Factors influence peoples' walking were studied by many researchers however there are very few in the Asian region and no studies found on the walking preferences of university students in Sri Lanka. We believe that the results of the study could be helpful for define strategies on planning for sustainable transportation which can be adopted pedestrian planning in other urban areas. The main objective of this research is to identify key factors affecting university students' preference of walking and assessing these factors to identify the significance of each factor for the contribution of walking.

2. Why Do We Need to Walk?

Increasing the Green House Gas concentration in the atmosphere has led to climate change and due to that world is experiencing a tremendous number of natural disasters that cost the number of human and property losses. In the global context, the transportation sector accounts for 24% of global greenhouse gas emissions in the year 2019. Greenhouse gas emissions from this sector primarily involve fossil fuels burned for road, rail, air, and marine transportation. CO2 emissions from transport (% of total fuel combustion), in Sri Lanka, were 47.73% as of 2014. IEA Statistics (2014). Nevertheless Sri Lanka incurs a huge economic loss of around 40 billion Rupees annually due to road traffic congestion and air pollution with too many vehicles on a limited road network. Unless the authorities take measures to modernize and improve public transport, the country cannot curb this massive, unproductive cost. Amal S. Kumarage (2010).

According to research findings physical activities such as walking is associated with numerous health benefits such as such as obesity prevention, reducing risk for cardiovascular disease, diabetes and certain cancers, and improvements in mental health and sleep. Duncan et al (2016). Further, it helps to create equitable, livable, cost-effective, environmentally sound, and safe cities. Many countries have been identified walking is an environmentally friendly alternative transport to motorized transport. Supporting pedestrian mobility is a key factor in a sustainable urban development. However there is few literature on how far people actually walk or about how street design affects peoples' willingness or capacity to access desired destination on foot.

2.1 WHY DO PEOPLE WALK?

People practice walking for different purposes and it mainly combined with leisure, personal care, transport, study, and work activities Armstrong and Bull (2006) and the World Health Organization., (2002). In the US, Canada, and Europe, walking is the most common form of leisure-time physical activity. Gilmour (2007), Kenyon et al (2002) Pucher and Dijkstra (2003). In the U.S and likely in Australia, a major reason for walking in urban areas, is walking to and from transit Besser and Dannenberg (2005); Agrawal and Schimek (2007)., Besser and Dannenberg (2005) find that "Americans who use transit spend a median of 19 minutes daily walking to and from transit".

Walking was the only available land transportation mode available in ancient Sri Lanka, only kings and high ranked officials rode horses. Public transportation was introduced in 1907 as an owner regulating service and there was no regulation and un-availability of a good road system it was not much popular Manukulasooriya (1979), Pabasara et al (2016). However, with the introduction of open economy, dramatic changes were occurring in the country. Demand for the private vehicles was increased dramatically and road systems were developed. There are more than 6 million vehicles registered Department of Motor Traffic, Sri Lanka, (2016), and the active vehicle fleet are about 5 million, which is a three-fold increase with respect to the year 2000 INDCs, (2016). Walking is practicing by Sri Lankans for many days to day purposes still it is not the most popular mode of transportation in the country.

2.2 FACTORS INFLUENCE THE WALKING

Mahalwat et al (2007) state that economic factors such as travel cost, income, expense etc. and demographic factors such as gender and ethnicity are important for the decision of walking. Kim et al (2011) divided factors influence on walking in to two categories; a physical environment which consist of traffic, sidewalk, network and safety elements and human subjective elements are ones that could be differently represented depending on individual performances., However, there is very little literature on how far people actually walk or about how street design affects peoples' willingness or capacity to access the desired destination on foot. Until the mid-1990s', pedestrian behavior was virtually ignored in the transportation and planning literature. Yet micro-scale urban design and environmental factors were often ignored Agrawal et al (2008).

Distance: According to the study of Olszewski and Wibowo (2005) average walking distances is more than 600 meters to transit in Singapore and over 40% of transit riders in Toronto residing over 300 meters distance from transit. Alshalalfah and Shalaby (2007). Distance matter work, study, commercial transit-oriented walking. The average distance people would like to travel only 500m or less than 1 km for this type of trip purpose. Office people, students like go to offices, schools, and universities with a fresh mind without tired in the morning time because they need to spent the whole day at offices, schools and universities. Some office places, large transit stations provide facilities to have a bath to encourage walking.

Duration: Same as the distance, duration matter to increase work, study, transit-oriented walking. These types of trip purposes need to be faster than leisure, shopping walking. According to the

research study by Hewawasm et al (2013) the survey results conclude that shorter distances and lower travel time are significant for the pedestrian movements. The average time duration people would like to spend work, study trip purpose 6minutes or less than 10 minutes.

Availability of Infrastructure: Availability of infrastructure facilities such as sidewalk or footpath boost people's perception of walking. Some researchers have been found sidewalks to be significantly associated with travel walking. Forsyth et al (2008). The landscape associated with sidewalk especially large trees with shades, benches to sit, and rest attract more people to walk. Leisure walks tend to increase with this type of infrastructure availability. Whereas walking to school has been found to increase where there are sidewalks along main roads. Ewing et al (2004); crossings, an absence of busy roads. Giles-Corti et al (2009).

Safety: Hence sidewalk footpath availability increases children and their parents' perception of walking considering safety. Safety from crime at day time. Hawthorne (1989) lighting at night time is important factor to decide people's perception of walking. Whereas unappealing environmental qualities included air pollution, litter and garbage, dangerous street crossings, traffic noise, poorly maintained footpaths, and the presence of skateboarders and cyclists on footpaths discouraged people's view of walking.

Environment factors: Many researchers has identified environment factors, such as visual attraction, pollution, and cleanliness are less important factors for work, study purposes walking, as distance and duration. Hewawasam et al (2013), although they are important for the leisure walking that increases the quality of the experience. As state by Ranasinghe et al (2013), pedestrianization has become an integral part of the sustainable modern urban design, where pollution-free, convenient, safe, and comfortable pedestrian facilities are ensured. The National Consumer Council in the The United Kingdom reported that a pedestrian environment should be: clean and visually attractive, free from conflict with and the threat from vehicles and the side effects of traffic, such as noise and pollution, comfortable and convenient, and personal safe. National Consumer Council (1987).

Policies and Practice: Urban planning and transport policies and day to day practice provide additional insights into factors that could affect patterns of people walking. Among urban design and planning agencies, the policy focus is on the creation and development of "healthy" or "live-able" communities. Transport agencies, on the other hand, are primarily concerned with the transportation of goods, the management of traffic, and only more recently has their attention turned toward the provision of routes for people to walk and cycle. Pikora et al (2012). Policies and practice are vital factors to encourage people's perception of walking. At presently most of the countries have been taking actions to promote walking.

Considering the walking preference of students Mahalvat et al (2007) state apart from the economic and demographic factors, travel time is also a significant factor for students in selecting travel mode. Parisi and Hondorp (2005) have shown that distance, traffic, and crime are three key factors preventing students from walking/ biking to school. Also Zhou et al (2009) found that factors such as distance, safety, climate pathways, time, violence or crime affect children's' walking or biking. Rates of walking to school vary widely across the globe. Less than 15% of US schoolchildren walked or biked to school in 2001. Martin and Carlson (2005). This compares with a walking rate of approximately 50% for British children in 1999–2001 and 27% of children in Melbourne, Australia in 1993–1996. Ampt (1996); Pooley et al., (2005). However, there is no literatures are available regarding preferences or statistics on the walking of Sri Lankan students. The notion of what we can be developed reviewing the literature is walking has linked with every kind of activity.

3. Study Area

Both universities selected for the study are located in the Colombo district which is the capital economic center in Sri Lanka. The land use pattern is urban. Climate is tropical; average annual temperature 26.9 °C and the average annual rainfall is 2516 mm (Department of Meteorology, Sri Lanka) and the terrain is flat around both universities. Although other environmental factors such as

shading trees, visual cleanliness, socio-economic and physical features such as the built environment is different. There are approximately 10,000 students in the University of Moratuwa (University of Moratuwa official web site) and about 13,000 students in the University of Sri Jayewardenepura (University of Sri Jayewardenepura official web site) both undergraduates and postgraduates. There are many travel mode options available for both universities' students including, walking, biking, driving alone, and taking a bus.

University of Moratuwa

University of Moratuwa (UOM) is located in Katubedda, Moratuwa, facing the 255 bus route. It has more than 1km distance from Galle Road and a continuous 255 bus supply, presented in figure 1. In addition to that Molpe bus also has been running between University and Kutubedda Junction frequently. Therefore the majority of students have been using 255 buses to come to the university from Katubedda Junction. Whereas students are starting to walk onward Mola Road. It has approximately 500m distance between Mola Road and University.

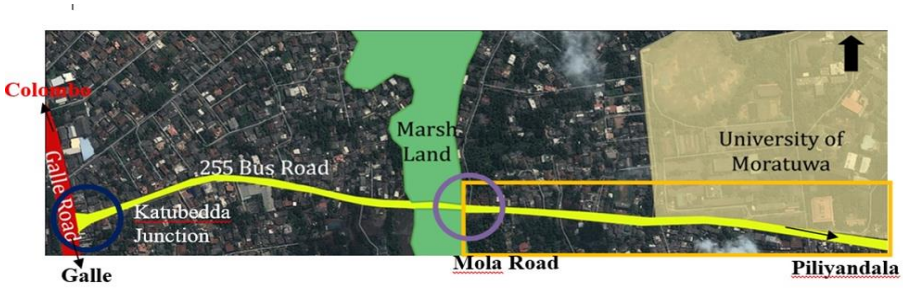

Figure 1, Location Map of UOM (Source: Author)

University of Sri Jayewardenepura

University of Sri Jayawardhanepura (USJP) is located in Gangodawila, Nugegoda close to Sri Jayewardenepura Kotte the capital city of Colombo. It has approximately 500m distance from Wijerama Junction to University figure 2). It has only 2 buses run via university in between Wijerama Junction and Piriwena Junction.

Figure 2, Location Map of USJP (Source: Author)

4. Methodology - Assessing Student Walking Practices

Based on the literature review, a framework has developed for assessing students' preference for walking, presented in figure 3. The framework has three key features: Functional, Safety, and Aesthetic and under each feature, there are a set of elements. The below chart included elements that were considered under each feature to assess the student walking practices. Field verifications were conducted on walking practices of students in the University of Moratuwa and the University of Sri Jayewardenepura.

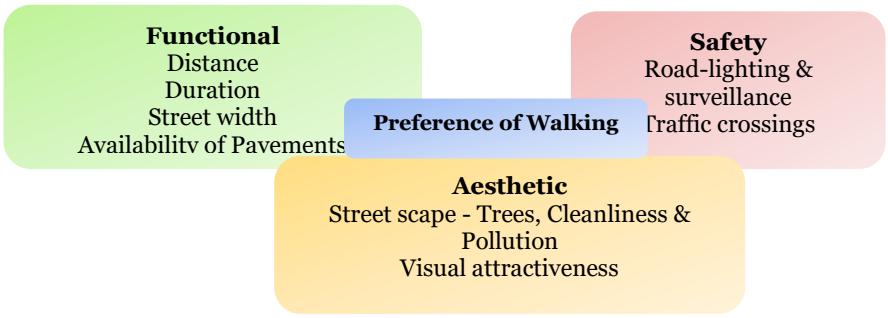

Figure 3, Framework for Assessing Student Walking (Source: Author)

Data were collected through a short questionnaire survey. 150 university students were selected randomly from each university and examined their transportation mode and reasons to select or not to select walking according to the framework.

5. Results and Discussion

According to the field observations number of students practicing walking at the University of Sri Jayewardenepura from Wijerama junction to university is higher compared to the University of Moratuwa. It is a unique feature at the Soratha road always full of University students walking here and there while most of the students from the University of Moratuwa are using 255 buses to reach the university. Why do the University of Sri Jayewardenepura students choose to walk and why the University of Moratuwa students do not choose walking option to reach to the university was evaluated using the proposed framework and results are discussed below.

As per the analysis University of Moratuwa, from 150 students surveyed, 55 students were selected walking as a transportation mode. As a percentage it is 37%, among that 20% used Mola road to reach the university. University of Sri Jayewardhanepura students 97 students selected walking rather other transportation modes. As a percentage it is 65%. .

5.1 FUNCTIONAL FEATURES

Distance: Under the functional feature first element is distance. Katubedda Junction to University of Moratuwa has approximately 1km distance whereas Wijerama Junction to Jayewardenepura University has 500m distance. So it is very apparent students of Jayewardenepura have more walking preference than Moratuwa because average distance people tend to walk is around 500m. Students of Moratuwa also have been starting to walk on ward Mola Road. Students who are settled close to Mola Road have been practicing walking at presently.

Duration: Duration also same like the distance to walk 1km distance takes more time whereas to walk 500m distance takes less time. Hence it has proved that lesser distances and durations encourage people participation of walking through comparative analysis of these two universities.

Street width: Both of roads have two lanes. In terms of width both of the roads does not have any vast different. But the 255 bus road condition is good than Soratha road.

Availability of pavement: The 255 bus road has separated bicycle lane while Soratha Road new pavement construction works are going on by the time of study. Condition of the roads are shown on image 1 and 2.

Traffic volume and Speed: Both of the roads do not have high traffic. Although during the peak hours there is a traffic congestion near Wijerama junction on the high level road, not towards the

university. On street parking is common to both roads. Vehicles are parked in both sides of the roads obstructing pedestrian lanes.

Image 01: The 255 Bus Road.

Image 02: Soratha road

5.2 SAFETY

Road lightning and surveillance: Road lightning is available in both roads but surveillance systems are not. However on the both sides of the Soratha road there are dense built areas; including bookshops, food restaurants and communications and they have personnel surveillances. Therefore students tend to walk in the Soratha road without fear because they feel safe whereas the 255 road condition is other way.

Traffic Crossings: Both roads have standard road crossings in good condition. In terms of traffic crossings both of the roads are secured (image 3 & 4).

Image 03: Road crossings - 255 road

Image 04: Road crossings - Soratha road

5.3 AESTHETIC

Availability of shading trees: Both roads do not have continues stretches of shading trees only few trees are existing.

Cleanliness and Pollution: Based on the visual observations both roads are polluted with litter along the road side however 255 road is better than the Soratha road.

Visual Attractiveness: The 255 road is going through a marsh land therefore 255 road has nice views than the Soratha road.

6. Conclusion

This study investigated the factors affecting people preference of walking as a leisure, work, transit, study and shopping activity through past research works. Built environment, distance, duration, availability of infrastructure, safety and policies and practices are the main factors that enhances the

people preference of walking. The research assessed key selected factors that affect the walking preferences of university students comparing two universities having two distinct characteristic in terms of student preference of walking.

According to the findings it is obvious lesser distance and less time attract more students to walk. Therefore distance and duration has significant contribution to determine walking. Distance and duration highly matters of selection of walking for purpose like studying. If we compare walking as leisure activity no arguments the 255 road attract more walking people than the Soratha road. The 255 road also attracted more walking students onwards Mola road that is the desirable distance of student to walk for the purpose of study. In terms of road conditions and aesthetic difference of two roads are not much significant as distance and duration. But we can't avoid these features although contribution is less. To some extent these factors also contribute to student perception of walking.

Another significantly contributed feature to determine walking is safety. Safety in terms of crimes is big threat to reduce walking behavior of people. Not only the crimes, availability of lights, traffic and crossings also need to be considered under the safety. The findings have been revealed that the Soratha road is better than the 255 road.

In addition to these factors availability of bus service also matter for student decision of walking. 255 buses are frequently available at the Katubedda Junction. As a result of that students tend to use bus service to come university than walking.

Assessing those factors is vital in many ways. The study can be further developed by assessing walking preferences with another university in different physical, demographic and socio-economic features. Policy makers can be used these findings to develop policies to encourage people perception of walking. Urban Planners can be developed strategies to encourage people perception of walking identifying situation properly.

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GENDER AND DISABILITY INCLUSION IN POST-DISASTER REBUILDING 'BUILD BACK BETTER' PROGRAMMES IN SRI LANKA: A LITERATURE REVIEW

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Abstract
In the last decade, many South Asian developing countries have suffered natural disasters. Severe disaster destruction results in an overwhelming need to rebuild housing and infrastructure within a brief amount of time. United Nation Development Programme has sought to make this reconstruction program a "Build Back Better (BBB)" opportunity, hence gender inequality and marginalisation of people with disabilities remain a problem in many countries. Although the international community has sought to promote this resilience and inclusion, the Post-Disaster Rebuilding (PDR) process still overlooks these sectors of society and their needs. Therefore, this paper aims to bring in literature synthesis addressing gender and disability inclusion in PDR 'BBB' programmes in Sri Lanka. Besides, involvement in the mitigation of vulnerability and community resilience to disaster risks and relocation was found to play a significant role. Vulnerability and the risk of disasters can be dramatically reduced by ensuring a culture of disaster prevention and resilience for all segments of populations, particularly rural areas, girls and women, and the disabled. All aspects of socially inclusive, formal, and non-formal commitments are important to take their desires and requirement into consideration.

Keywords: *Build Back Better (BBB); Disability; Gender; Post-Disaster Rebuilding (PDR).*

1. Introduction

During the past decade, many developed countries have experienced several natural disasters in South Asia (Bangladesh, Sri Lanka, Pakistan, and India) (United Nations Office for Disaster Risk Reduction [UNDRR], 2019). The physical destruction that accompanies disasters creates an urgent need to rebuild housing and infrastructure facilities within a short time (Kennedy *et al.*, 2008). United Nations Development Programme (UNDP) has tried to make this re-building programme an opportunity to 'Build Back Better (BBB)' (UNDP, 2009), where the built environment responds to the needs of many and long-term sustainability, contributing to the re-settlement and healing process of the community. To safeguard a resilient and sustainable recovery, the Sendai Framework for Disaster Risk Reduction and more broadly, the Sustainable Development Goals, emphasise that Disaster Risk Management (DRM) and development planning should be inclusive of all fragments of the society comprising gender, disable, vulnerable and marginalised (UNDRR, 2019). Even though the international community has attempted to embrace this resilience and inclusion, in practice, these segments of the society and their needs are often overlooked throughout the re-building process (Robles, 2019).

In Post Disaster Rebuilding (PDR) Programmes in South Asia, adequate gender and disability data is hard to come by. Further, this is even more difficult when disability perspectives are still largely marginalised in existing DRM planning and programming (Drolet *et al.*, 2015). Limitations in obtaining reliable gender and disability data are due to several factors including the inadequacy of tools used to capture data, constraints in obtaining information about disability registrations, low prioritisation, and social stigma, among others (United Nations, 2019). Given this context, any initiative to promote and support gender and disability inclusion must undertake measures to understand conditions that hinder or enable participation of women and men with disabilities in PDR.

Sri Lanka has been affected by multiple disasters triggered by both natural and manmade hazards. Besides, the recent floods and landslides in Sri Lanka in May 2017 contributed to an extensive economic loss and damage to communities and their assets. The country faced its worst natural disaster by the Indian Ocean tsunami in 2004 and droughts in 2016 and 2017 (Wickramaratne *et al.*, 2012). Further, Sri Lanka fought a civil war for decades that ended in 2009 and the reconciliation

process in the post-war situation is still underway (Ministry of National Policies and Economic Affairs, 2016). Hence it is a unique location to initiate research that contributes to the wider 'BBB' programme and the inclusivity in PDR. Besides, though there are studies carried out on PDR 'BBB' programmes worldwide, less attention had been paid for gender and disability inclusion. Moreover, there is a dearth of literature on gender and disability inclusion in PDR 'BBB' programmes in the Sri Lankan context. Thus, this paper aims to bring in literature synthesis addressing gender and disability inclusion in PDR 'BBB' programmes in Sri Lanka.

2. Methodology

A comprehensive literature synthesis was adopted as the key methodology based on which this paper is produced. Saunders, Lewis, and Thornhill (2016) found that a robust literature will make sure that new research-related information is contextual and that the study creates original expertise that is missing from existing literature. A thorough literature review is, therefore, necessary to gather current information in the research field and pave the way for new information to be discovered. Hence the authors reviewed key relevant literature on major databases. The disaster management was considered as a discipline in Sri Lanka after the Indian Ocean Tsunami in 2004 and the BBB concept was initiated in 2006. Hence the literature focused on the journal articles and reports that were published since 2004. The authors have filtered the articles based on their relevancy to the research using keywords such as 'Build Back Better (BBB), Disability, Gender, Post-Disaster Rebuilding (PDR)'. The focus was also given on reports published by Sri Lankan authorities.

3. Literature Review

3.1. DISASTER MANAGEMENT

In 2017, the United Nations General Assembly (2017) officially accepted a definition of a disaster as "a serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability, and capacity, leading to one or more of the following: human, material, economic and environmental losses, and impacts". In recent decades, the frequency and severity of natural disasters in Sri Lanka have increased considerably (Amaratunga *et al.*, 2020). Natural disasters including landslides, floods, tsunami, high winds, and droughts have caused human, physical, financial, and environmental casualties and have had significant impacts on Sri Lanka's economy (Steele *et al.*, 2007). In particular, the three most common natural disasters which occur every year in Sri Lanka include floods, droughts, and landslides, which impact people's lives and livelihoods of a significant number of people. Based on available data, between 2009 and 2018, about 1,98 million people were affected every year by flooding, droughts, and landslides (Basnayake *et al.*, 2019). Moreover, the distribution of impacts depends on the level of physical, social, and economic vulnerability to natural disasters of a given area (Wickramasinghe, 2014). It highlights the need to figure out how to be more disaster resilient in the future (Amaratunga *et al.*, 2020).

'Disaster management'; basically meant 'disaster risk management' encompasses all activities which reduce the losses of life, property, or assets related to disasters by either reducing the danger or vulnerabilities of risk components (Khan, Vasilescu and Khan, 2008). According to the United Nations Office for Disaster Risk Reduction, disaster risk management focuses on organising and managing all emergencies and disaster responsibilities, including preparation, reaction, and initial recovery actions (UN Spider, 2019). Moreover, it covers the total of all actions, programmes, and measures that can be undertaken before, during, and after disasters to prevent, reduce and recover from disasters (Haigh and Amaratunga, 2010).

Pre-disaster activities are carried out to reduce possible consequences for human and property casualties. The measures taken at this level to reduce risks are called mitigation and preparedness (Khan, Vasilescu and Khan, 2008). During a disaster, initiatives are taken to minimise the needs and supplies of victims. Activities under this level are called emergency intervention (Enshassi, Shakalaih and AlKilani, 2018). In the post-disaster phase, steps are taken to respond to a disaster to recover and rehabilitate communities promptly after the disaster. These are known as response and recovery

activities (Salamati Nia and Kulatunga, 2017). In disaster management, the PDR phase is challenged with many obstacles in rending the disaster a chance for development because of its ineffectiveness and inefficiency.

3.2. POST DISASTER REBUILDING

Rebuilding is a redevelopment indicator that not only involves the development of physical structures, but also the development and rebuilding of confidence, compassion for one's self, autonomy, support for one another, and mutual trust. This long-term process focuses on the development of human and material resources, coordinated independence efforts, sustainability, and inclusiveness (Thurairajah, Amaratunga and Haigh, 2008). Even though the reaction to emergencies has improved, permanent reconstruction is often managed inefficiently, improperly coordinated, and slowly to get off the ground (Jones, 2006). Yet the PDR is a significant stage of disaster recovery that offers a window of opportunity for the development of the community. According to Halvorson and Hamilton (2009), post-disaster operations tend to be inefficient and poorly handled despite the enormous amount of disaster events, which require enhancement. Kennedy *et al.* (2008) pointed out that reconstruction of the built environment and infrastructure only as it was before a disaster also regenerates the same past vulnerabilities. Moreover, if the pre-disaster standard were restored, communities affected by disasters would encounter the same problems, if in the future they were exposed to another disaster. The post-disaster reconstruction and recovery duration offers a chance to address the vulnerabilities in communities appropriately (Thurairajah, Amaratunga and Haigh, 2008).

A concept began to emerge that after the disaster, rebuilding should be used, not only to rebuild what was damaged, and to restore the community to the pre-disaster state, but also to take the opportunity to improve physical, social, environmental, and economic conditions to create a new state of standards (Boano, 2009). This was called "Build Back Better (BBB)", which suggests that successful recovery in communities after disasters should combine the recovery and improvement of the constructed environment with psychological, social, and economic climatic conditions in a holistic way, to improve the resilience of the entire community (Clinton, 2006).

3.3. BUILD BACK BETTER CONCEPT

The term "Build Back Better" became common after a major rebuilding project after the Indian Ocean tsunami tragedy in 2004, after which the BBB recommendations for advice on rehabilitation and restoration were more explicitly implemented to accomplish the goal (Clinton, 2006; Mannakkara et al., 2014). BBB implies an ideal process for reconstruction and recovery that provides disaster-affected communities with resilient, sustainable, and efficient recovery solutions. The motivation behind the BBB principle is to reinforce and recover societies after a disaster (Mannakkara, 2015). In order to build better back on the local condition of the impacted population, the first step in PDR activities is to consider needs evaluations and surveys to provide the necessary assistance to support the population (Khasalamwa, 2009). Moreover, the policies of reconstruction and recovery must be formulated based on local requirements for the preservation and protection of local culture. Batteate (2006) stated that maintaining community participation is essential to BBB's success throughout recovery. Literature has emphasised the importance of decentralisation in enabling disaster communities to take responsibility for recovery efforts and be involved in policy-making (Mannakkara, Wilkinson and Francis, 2014).

The BBB principle reflects the government's idea of a resilient Sri Lanka too in the event of a disaster. As such UNDP in Sri Lanka, the National Building Research Organisation (NBRO), which is part of this proposal initiative, has collaborated to introduce a series of training and education programmes, which concentrate on BBB principles (UNDP, 2018). UNICEF has also set up a 3-year Tsunami Recovery Plan for 2005-2007 in the 10 most-affected districts in Sri Lanka, including the construction and rehabilitation of 36 health centres, water supply, and sanitation rehabilitation facilities as well as improvement, the building of 26 schools for the children, and the repair and building of 77 social care facilities for children emphasising the BBB concept (United Nations Children's Fund, 2005). 10 prepositions were introduced in BBB principles (Clinton, 2006), and the 2nd principle highlights that recovery must promote fairness and equity, which denotes that the equal consideration should be

given to the marginalised groups such as women and disabled people in PDR. Therefore the next section will describe the real need for the consideration of gender and disability inclusion in BBB programmes.

3.4. THE NEED FOR GENDER AND DISABILITY INCLUSION IN DISASTER RECOVERY IN THE PERCEPTION OF 'BUILD BACK BETTER' PROGRAMMES

It has been noted that most of the time disasters have a significant impact on those impacted, particularly for the most vulnerable communities (Sharma, 2014). Disabled people are now facing heightened challenges in crises in comparison to the rest of the population, in particular, because their social and physical environments offer opportunities to maintain and rehabilitate them (United Nations Economic and Social Commission for Asia and the Pacific [UNESCAP], 2015). Recognition of the systemic roots of disaster risks, rooted in the same processes that lead to social inequality, poverty, and exclusion, is a suitable lens for understanding why disasters tend to affect people with disabilities more severely (Tierney, 2015). Furthermore, it generates a discussion on how changing social and environmental conditions are vital to achieving the goal of rebuilding for the 'better' (Zayas *et al.*, 2017).

Disability is found to worsen the social impact of disasters, especially for women and girls who suffer from both disability and gender impediments (Enarson, 2009). Studies also have shown a higher prevalence of physical harassment and relationship violence among people with disabilities, problems that have been worsened in post-disaster settings. Cultural standards can already impede female mobility and access to disaster assistance in many societies (Zayas *et al.*, 2017), and this made it harder for disabled women to receive much-needed assistance and help if a disaster hits. Unfortunately, current policy procedures are often insufficient to address the multifaceted experiences of exclusion in the form of gender and disability, especially in disaster rehabilitation (Sharma, 2014). It was mentioned that while in some countries 'BBB' recovery initiatives are being implemented, physical environment barriers continue to persist (Khasalamwa, 2009). Most of the areas assessed were either not wheelchair accessible or contain obstacles to mobility along paths. Besides, many of the installations evaluated lacked handrails. In addition, comfort rooms often were not built to meet the needs of disabled persons, especially women. Public areas were not particularly suitable for the visually impaired. No tactile floors or braille labels provided the required directions or orders. The lack of signals is often disadvantageous for those with hearing disabilities. There were no trained personnel or employees in any of these institutions or public places to provide mobility assistance and information (Zayas *et al.*, 2017). Moreover, Disaster Recovery Guidance Note (Robles, 2019) has addressed the various post-disaster challenges that women face in recovery and rebuilding due to underlying inequalities and marginalisation issues. Besides, the note guided on how to transform the post-disaster situation into an opportunity for gender equality and women's empowerment, with a focus on "BBB," because new progressive gender roles and relationships can emerge aftermath of a disaster.

Since the 2004 tsunami disaster in the Indian Ocean has made BBB a symbol for disaster relief and restoration, it is worth questioning if populations are truly more positive if the process of recovery tends to shut out disadvantaged sectors such as women and people with disabilities. Besides, the concept of BBB has been advocated not only to rehabilitate and strengthen infrastructure and to rebuild systems and means of livelihoods but also to rehabilitate disabled people, women, girls, children, and men in the community concerned in a way which includes them (Kennedy *et al.*, 2008). It was stressed that "the BBB" criteria would include ways to mitigate gender inequality and improved equality by taking into account the needs found in the appraisal by recover, rebuild and pay lost properties and damages (Robles, 2019). This section presented the significance of gender and disability inclusion in BBB programmes. In order to make the inclusion effective and practical, it is necessary to have the policy level support in BBB programmes. Accordingly, the next section reviews the policies related to gender and disability inclusion.

3.5. POLICIES RELATED TO GENDER AND DISABILITY INCLUSION

The international policy frameworks covering the problem of increased disaster risk have evolved following the declaration of the International Decade on Natural Disaster Reduction in 1989 by the United Nations General Assembly Resolution 44/236. From the virtual inability to identify the unequal circumstances in the economically 'vulnerable' classes to the current comments on the need to consider disadvantaged industries, views on what defines and is better handled in disaster risk inevitably change towards more constructive participation and interaction of the local populations and social groups (Zayas *et al.*, 2017). While gender mainstreaming has been a continual work for gender scholars and advocates since the 1990s (Enarson and Meyreles, 2004), in reality, the integration of gender into disaster risks management and planning is largely an "unfinished" business, or even "unstarted" business in some parts of the world (Seager, 2014). Likewise, the international arena has fairly recently taken the inclusion of disability viewpoints with disaster risk management.

The Hyogo Framework for Action 2005-2015 for mitigating disaster in the aftermath of the 2004 Indian Ocean tsunami, became more mindful of the need for "vulnerable people' to cope with threats, but only addresses disabled person (Priestley and Hemingway, 2007; United Nations International Strategy for Disaster Reduction, 2005). The Sendai Framework for Disaster Risk reduction 2015-2030, which was set up in conjunction with other vulnerable groups, such as women and children, during the Third World Conference on Disaster Risk Reduction, is more explicit in the inclusion of persons with disabilities (United Nations, 2015). Here, women and people with disabilities are listed as core players in the processes of disaster risk management planning and implementation (United Nations, 2015). More specifically, it supports accessibility as an important factor in ensuring the successful participation of disabled persons. In Sri Lanka, the NBRO also works on promoting the Sendai Framework, especially for Priority three to invest in reducing resilience risks from disasters.

Since disaster risk management is unavoidably related to development processes, gender and the inclusion of people with disabilities are also obvious in the establishment of the Sustainable Development Goals, the United Nations Convention on the Rights, and the Incheon strategy "making the right real" for disabled people in Asia and the Pacific 2013-2022, among others (UNESCAP, 2012). The global framework that has evolved so far from attempts to advocate and campaign for women and people with disabilities provides the institutional driving forces for more equitable disaster risk management and development planning initiatives (Zayas *et al.*, 2017). These global developments also serve as the basis for some of Sri Lanka's policy structures dealing with gender and disability in the management of disasters risk. Such as; Disaster Management Act (2005), National Policy on Disaster Management (2010), Convention on the Rights of Persons with Disabilities, National Action Plan for Disability, Gender Action Plan, The Roadmap for Disaster Risk Management (2006-2016), Sri Lanka National Disaster Management Plan (2013-2017), Comprehensive Disaster Management Programme (2014-2018), National Adaptation Plan for Climate Change Impacts in Sri Lanka (2016-2025), and (Draft) National Disaster Risk Management Plan (2018-2030). In Sri Lanka, the Disaster Management Act, National Policy on Disaster Management, the Roadmap for Disaster Risk Management, Sri Lanka National Disaster Management Plan, Comprehensive Disaster Management Programme, National Adaptation Plan for Climate Change Impacts in Sri Lanka, and National Disaster Risk Management Plan have given attention for marginalised groups especially for women and disabled people in PDR processes. Besides, there are some action plans in Sri Lanka, which highlights separately the inclusion of women's needs as well as the needs and rights of disabled people.

3.6. CONCEPTUAL FRAMEWORK ON STAKEHOLDER MAPPING

It has been recognised that, during PDR preparation, governance, and development, all individuals and communities impacted by disasters should actively take part in decision-making (Drolet *et al.*, 2015). Following the Sri Lanka Disaster Management Act No 13 of 2005, which was passed by the Parliament of Sri Lanka on 13th May 2005, the Disaster Management Centre (DMC) was established. The DMC is currently working under the jurisdiction of the Ministry of Disaster Management and Human Rights. Besides, DMC must coordinate and cooperate with the ministries, departments, local authorities, Grama Niladhari divisions, armed forces, police, and foreign Non-Governmental

Organisations (NGOs) to handle the overall risk management process in Sri Lanka (Ministry of Disaster Management, 2009). In Sri Lanka, the stakeholders can be categorised into three levels such as local, provincial/district, and national level. In each level, there are three different communication and commanding line in between the stakeholders. They are top-down, bottom-up, and both ways. However, in the post-disaster recovery processes, the participatory and bottom-up approach led by impacted communities has strong potential to help meet their needs (Drolet *et al.*, 2015). Based on the initial understanding on the national and local governance structure, a conceptual framework on stakeholder mapping was developed by the authors as shown in Figure 1. The purpose of the conceptual framework is to understand the relationships between the key stakeholders involved in PDR and explore the level of implementation of the policies related to gender and disability at national, provincial, district, and local level activities.

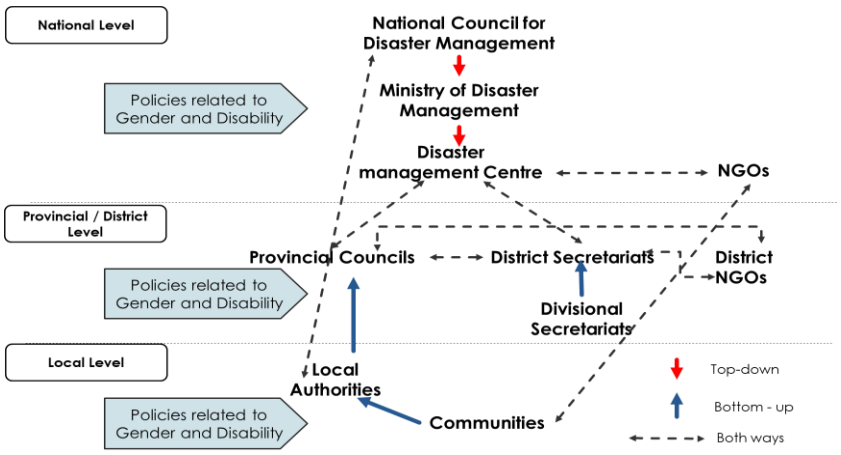

Figure 4, Conceptual framework on stakeholder mapping

This conceptual framework will be used to collect primary data through stakeholder interviews, which will be the next phase of this research. The intention is to refine the conceptual framework by elaborating on the communication and commanding line between the stakeholders in the context of PDR and identifying the specific policies related to gender and disability at different levels. The refined stakeholder interviews informed framework will present a clear stakeholder mapping to this research.

4. Conclusions

Multiple disasters, both natural and man-made, have affected Sri Lanka. The Indian Ocean tsunami in 2004 and droughts in 2016 and 2017 confronted the country with its most serious natural disaster. Moreover, for decades that came to an end in 2009, Sri Lanka fought a civil war and the post-war reconciliation process is still underway. Moreover, gender discrimination and marginalisation of people with disabilities remain an issue in many South Asian countries in any post-disaster circumstances. PDR extends beyond the building of new houses as the efforts to fix some issues would be challenging without knowing state, political or cultural dynamics. 'BBB' rebuilding was often linked to restoration of infrastructure and facilities, often without much gender and disability consideration. In the light of current and future disaster threats, gender and disability, and other social problems that intersect to create disaster risk, 'BBB' needs to be dealt with by efforts at disaster recovery that ensures that nobody is left behind. According to the literature findings, humanitarian agencies' interventions attempt to address these important aspects, but not entirely since they are beyond the range of many external risk factors and need collaboration with other stakeholders, particularly with the Sri Lankan government. Further, this paper will, therefore, offer a profound overview of the governance process followed in rebuilding and highlighting shortcomings and steps to include to improve the involvement of different segments of the community, including gender and persons with disabilities.

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GETTING INTO LIFE & LIVING OF LOW-INCOME FACTORY WORKERS

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Abstract
Dhaka city is with its unplanned urban growth, creating shortage of land in comparison to the ever-increasing population, and uneven distribution of residential lands among different income groups. Moreover, factories are flourishing in Dhaka city, but no attempt has yet been made so far, to provide adequate to the workers with low-income either by the government or the factory owner. A housing unit demands the qualities of comfort, conveniences, and amenities; however, this demand requires considerable chunk of land and renters or owners need to have financial solvency to dwell in. Here come the premises on housing affordability. The paper aims at understanding the pulse of low-Income peoples 'housing' that include settlement pattern, house forms, space allocations, group accommodations, breathing spaces and sharing of facilities and utilities and consequently provide them a viable environment where life and living turn into a delight.

Keywords: *Housing, affordability, settlement pattern, accommodations, low-income.*

1. Introduction

Dhaka city is one of the most populous mega cities of the world. It has never been possible to meet the housing demand of the low-income Families of Dhaka city. The recent fixation of wage of garment workers starting from 5,300 puts them into one of the subgroups of Middle-Income Category: Low-middle Income of income bracket Tk 5000 to 10,000. However, considering inflation workers are to be considered within Low income Category of the above statistical table of income bracket tk.2500-5000.These people are 35% of the total population of Dhaka city. Being one of the majorities they occupy only 20% of the cities residential land area. This large portion of the city's population mostly comprising of factory workers is living in informal sector housing such as slums, squatters, and messes under unhealthy living condition with low quality houses, inadequate physical amenities, and social services. Dhaka has some of the highest neighbourhood densities where some slum (shantytown) population densities reach up to 4,200 per acre and even more.

There are several parameters of the physical requirements of housing affordability namely land, price, infrastructure cost, building material and construction cost and space allocation that are responsible for increasing the housing unit price and thus the rent. The localities of Mirpur, Gazipur and Savar of greater Dhaka city (where a good number of factories exist) have buildable land and the prices are still comparatively lower. Affordability for this income group also calls for housing that are 'reasonably adequate in standard and location' does not cost so much that a household is unlikely to be able to meet other basic needs on a sustainable basis.

2. Literature Review

Population explosion and massive urbanization are two strong forces that is shaping our cities of present world. In developed countries almost 84 per cent people will live in cities by 2030 where the percentage of people in developing countries will be over 56. The concerning issue is throughout this process a huge number of city dwellers are already living in below standard conditions. A sample of 116 cities shows that for Africa, Asia, Latin America and Oceania, a house or yard water connection exists in only 40 to 80 per cent of households, whereas levels of access to a sanitation infrastructure is far worse, at only 18 to 41 per cent (UNDESA, 2004). These numbers imply that the low-income people of our societies are living without proper facilities and most cases at unhealthy situations.

Studies in environmental psychology suggest the following four culturally determined basic spatial needs that are universal to human beings:

- The need for privacy
- The need for personal space
- The need for easy access to social interactions
- The right to safe and defensible space

For design of domestic space and housing, the components of the cultural determinants are personal space, territoriality, privacy regulation and boundary controls. Privacy is a universal phenomenon—is manifested differently in different cultures. The common element is the control of unwanted interpersonal interactions and communication. The rules and symbols of privacy controls influence the flow of information and communication at individual, group, and social levels. But this is an utmost necessity even for people with lowest income range anywhere in the world.

Based on proxemics' or the study of people's use of space, Felipe and Sommer (1972) defines personal space. In a personal space invisible boundary are created in relation to each individual and the boundaries define a set of concentric zones of accepted behaviour. Also stress among persons is created if the zones are violated without warning. The design and use of domestic activities are organized by the cultural pre-disposition related to the meaning of binary oppositions. These binary oppositions include male and female, public and private, front and back, clean and dirty, symbolic and secular. It is also important that the ordering of domestic activities and spaces ought to conform to prescribed cultural conventions. Though it is seen that people manipulate the pre-defined spaces according to their needs and people with lower income range tends to compromise the basic demands of a comfortable living space.

Hence for designing a living space for low income working people with minimum facilities the idea of adequate shelter is considered. Adequate shelter means more than a roof over one's head. It also means adequate privacy; adequate space; physical accessibility; adequate security; security of tenure; structural stability and durability; adequate lighting, heating and ventilation; adequate basic infrastructure, such as water-supply, sanitation and wastes-management facilities; suitable environmental quality and health-related factors; and adequate and accessible location with regard to work and basic facilities; all of which should be available at an affordable cost. (Habitat Agenda and Istanbul Declaration UNCHS (1996,50). In our study Largely three types of income groups are found among nuclear families. The income of the workers is ranged from 5000 BDT to 15000 BDT. Depending on the income the economic classes are identified, and each class has its own set of dwelling pattern and social facilities according to their affordability.

3. Objectives

- In local context, extensive reconnaissance survey on the living pattern of factory workers as for example living condition on the whole, internal arrangement of housing unit, different types of relevant house forms or housing options available to workers, the settlement patterns and its incremental development.
- Analyse the information and data in terms of physical, social, and economic aspects. List the pertinent requirement of BNBC code and standards.
- Then arrive at a cut-off point regarding the spatial requirements, choices on building materials and construction techniques, provision of necessary facilities and utilities and open spaces set ups.

4. Methodology

In this study the total process has been conducted in two phases.

4.1. PHASE 01 – STUDY

In the Kabirpur, Savar study area 06 factories are identified within 2-3 miles of the selected location of the slums, squatters, and messes in the ward map where the workers live. Similarly, in Ershadnagar that number was 09. Literature search and Field Study alongside sketches and photographs was conducted to collect the necessary data and information on

4.1.1. Settlement features:

Land-uses, Housing stock, Density, Infrastructure, Facilities and services, civic amenities, general layout, the morphological growth of the settlements.

4.1.2. Physical aspects:

The relevant house forms and housing options available to workers- internal layout and arrangement of units, organization of spaces, space hierarchy, allocated space per person within the built form, Open and built area ratio, Building material and construction techniques etc.

4.1.3. Social Aspects:

Privacy, Demographic facts, Gender issues, security, profile of dwellers.

4.1.4. Economic Aspects:

Income, Expenditure, Saving, Land value and rents paid.

4.2. PHASE 02 – ANALYSIS AND RECOMMENDATIONS

Analysis of information and data to formulate a program where conclusive statements on spatial requirements and allocations, choices on building materials and construction techniques, provision of definite facilities and utilities and open space system in accordance to standards and BNBC code.

5. Living pattern of factory workers

Most of the garment factories are situated in Savar, Narayanganj, Gazipur, Keraniganj and some areas like Mirpur, Badda in Dhaka. House rent in those areas is very high and because of low wage workers have to live in slum or slum like establishment for example shantytown. These places are very cramped and dilapidated and derived of most of the basic facilities. Numbers of toilets are also incongruous comparing to the numbers of inhabitants. Every morning dwellers have to stand in a long queue to go to toilet and get water for household works. The environment in which workers live is very asphyxiating and choking. So, garments factories are not paying these workers a minimum amount to have a liminal decent living place. Our study areas were Ershadnagar of Tongi and Kabirpur of Savar.

Most of the houses of Kabirpur are beneath standards. Landowner built those houses arbitrarily and improperly. The numbers of toilets are very inappropriate compared to numbers of inhabitants. There is lack of attached toilets and kitchen. Most of the families share only one kitchen. The toilet is a sanitary one but it is very scruffy and filthy, emanating rancid odour. In some situation there is family of 5-6 members live in a single room because they cannot afford the cost of two rooms. When any guest comes from their village it becomes very difficult for them to accommodate. Also, there is no privacy.

Figure 1, Site plan and surrounding existing condition of study area- Kabirpur, Savar

In Ershadnagar, the inhabitants do not pay any rent and do not need permission while extending their dwelling units for any economic activities. The types of home-based jobs and their working spaces in each individual family have different features. As the spaces are very congested, they have to find or create their own working spaces, within this limitation. Therefore, it is important for the bustee people to find the types of jobs, which are suitable in these dwelling units. Thus, flexibility of space is vital for the families who are involved in home-based production because the lack of space forces certain home-based work to choose spaces that are not suitable for such activities.

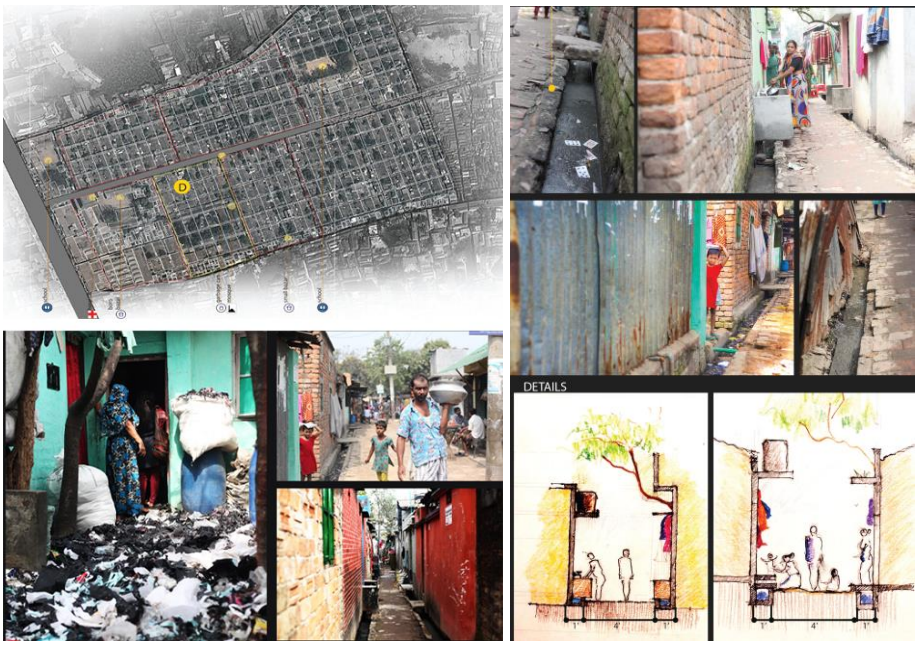

Figure 2, Site plan and surrounding existing condition of study area- Ershadnagar, Tongi, Gazipur

6. Case studies

While interviewing the workers were asked whether they can save money after paying their lively costs. They said that their intention before migrating to city life was to save some money then come back again to their roots. But they cannot save money for their future. In this paper we illustrate the living pattern of three factory worker according to their own explanation.

6.1 CASE STUDY 01

A 17 years age old girl Swarna from Bikrampur. She came to Ershadnagar, Tongi, Gazipur, when she was 6 years old with her parents. Life has always been harsh to her. She started working as a garment worker when she was in primary school. Her current salary is 8000 takas. She says it is very hard to maintain her family with it. Their family income in total is 14000 takas. But the expenditure is 15000 taka / month. So, there is no savings. Her family has to share a toilet and a kitchen with another family of 07 members.

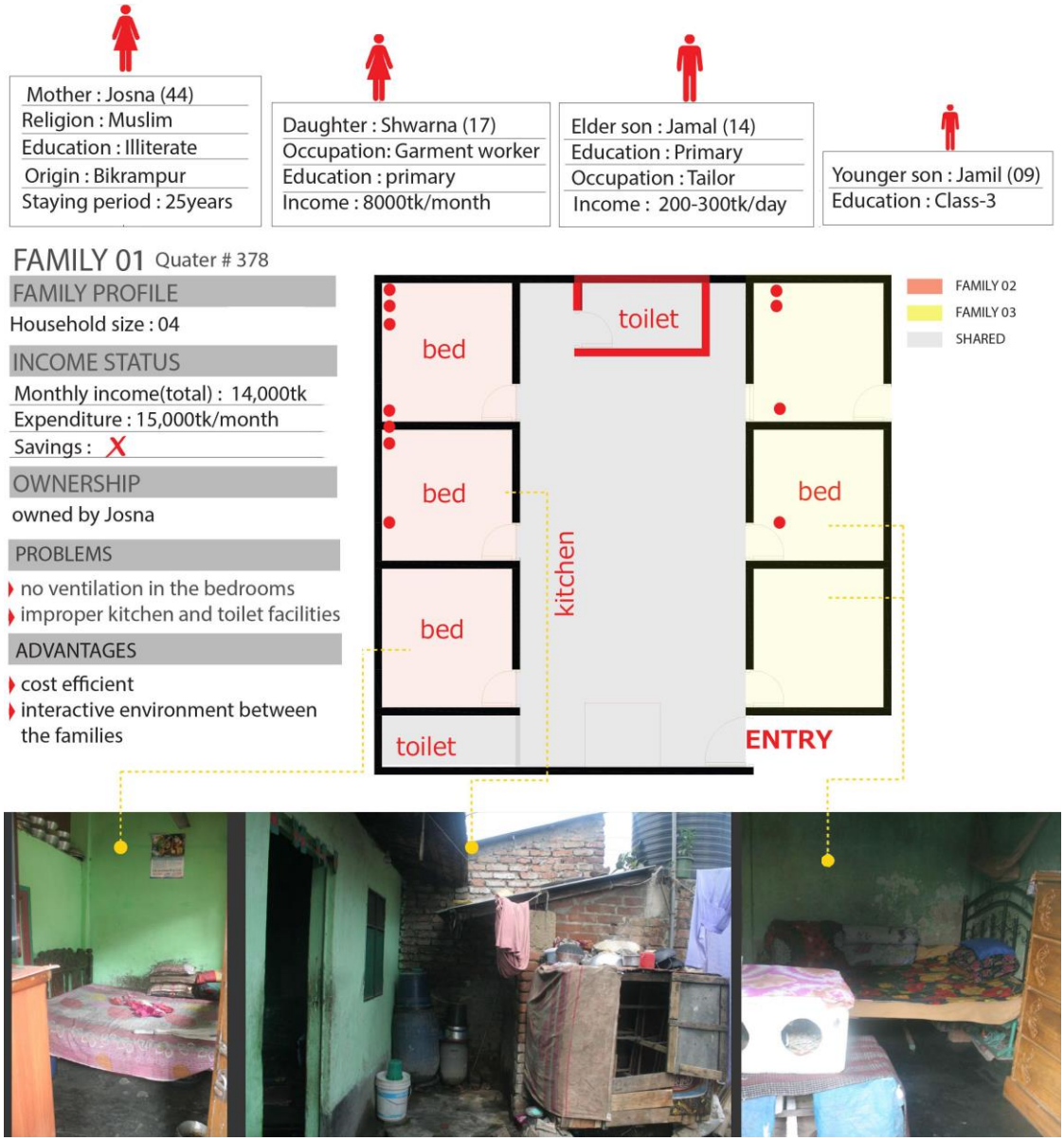

Figure 3, Illustrated Plan and existing condition of dwelling type of case study 01- Ershadnagar, Gazipur

6.2. CASE STUDY 02

Habibur Rahman (50) has been working in this factory for 18 years and his salary is now 6400 taka and including overtimes he gets almost 10000 in a month. He says that it is very difficult to maintain his family with this amount of money. Delay of payment is a common incident. But expenditure is much higher than income. The dwelling has only one toilet which is used by 17 members. The previous

kitchen was converted to a bedroom and now shifted in open courtyard. The electricity bill is 100tk/month. They use clay stove for cooking and the drainage system is in extremely bad condition.

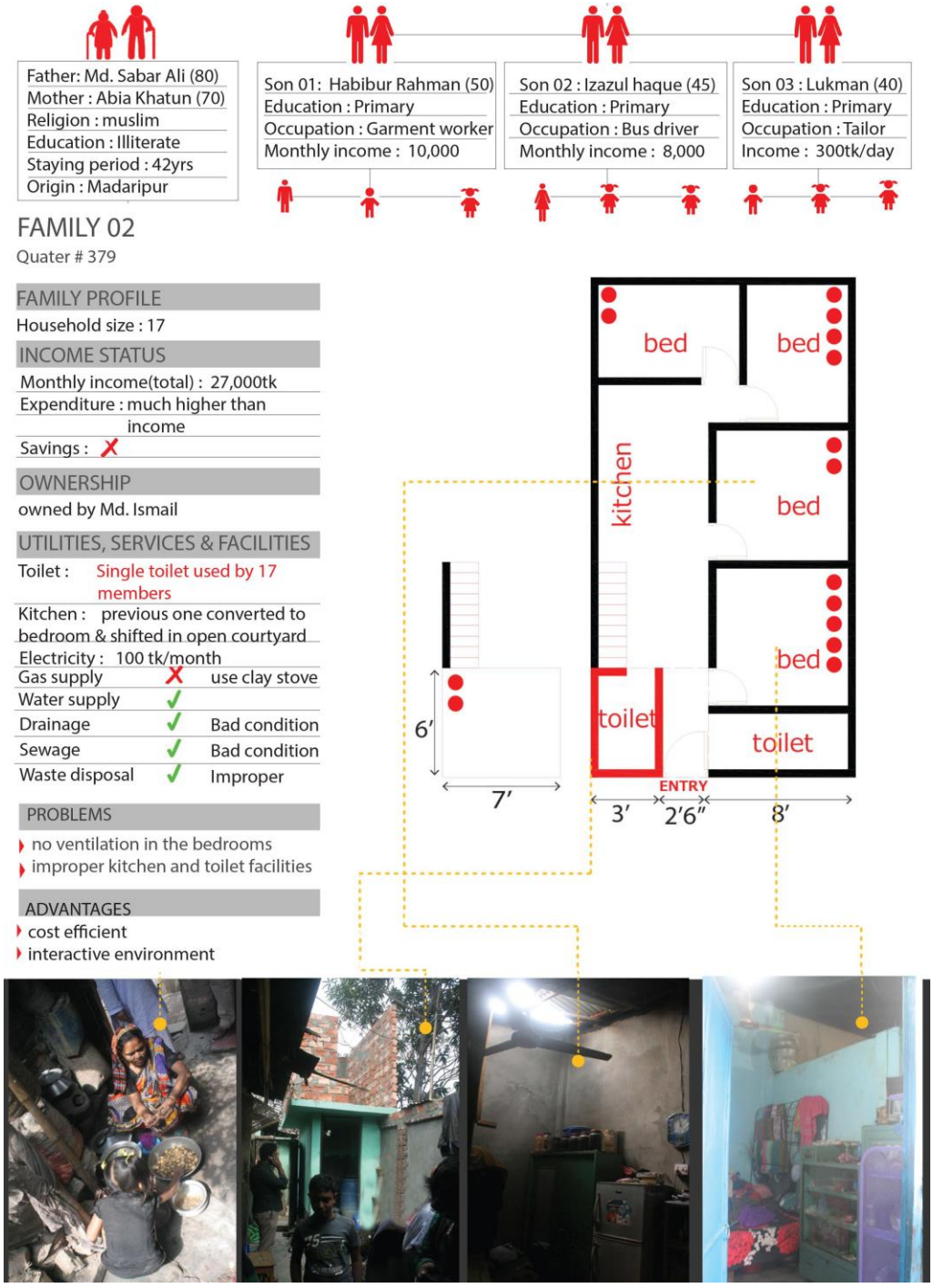

Figure 4, Illustrated Plan and existing condition of dwelling type of case study 02- Ershadnagar, Gazipur6.3.

CASE STUDY 03

Selina is another girl from Rangpur. She came Savar with her husband to alter the conditions of their life. Both Selina and her husband are garments workers in Polmal Pvt Ltd in Savar. At present they are living in Kabirpur, Savar. Her living place is a very congested space. There are separate toilets for

male-female but shared. Everyday morning, she has to stand in a queue to get water and then in another queue for having access to toilet. Her present salary is 6400 taka and she is an operator.

Figure 5, Illustrated Plan and existing condition of dwelling type of case study 03- Kabirpur, Savar

7. Findings

The study has brought about some comparison of facilities that represents different economic condition of workers. Although according to the rent the facilities in their dwelling pattern are not justified in these case studies. Whenever the income level increases, it is required that the affordability for house rent increases. When the rent increases, the facilities in their dwelling pattern needed to be get better than the people with lower income. This differentiation is absent in many aspects like the space for residing, the building materials of building construction, the necessary service facilities, privacy concerns, exposure to open spaces etc.

8. According to BNBC:

Habitable rooms:

One roomed dwelling unit shall have a multi-purpose room which may include an alcove or space for cooking	The min area of the room 12sqm/129.2 sq. ft with a min width of 2.5 m/8.2 ft
Two roomed dwelling units	The min size of any room 6sqm/64.6 sq. ft with a min width of 2.1m/7ft. The min total area of two rooms 15 sqm/161.5sq.ft

All habitable rooms shall have a clear height of 2.75 m/9ft
For sloped roof, the min average height 2.75m with a min 2m at lowest side
Kitchen:

One roomed house	Cooking space provided in multi-purpose room	Min area 2.25sqm/24.2 sq. ft & min width 1.2m/4ft
Two roomed houses	Separate kitchen	Min area 3.25sqm/35sq.ft & min width 5.2ft

Min clear height of the kitchen or cooking space shall be 7 ft or 2.15 m
Bathroom and water closet:

Independent water closet	Min width 0.9m/3ft, length 1.15m/3.8ft. The water closet shall be fitted with a door
Independent bathroom without water closet	Min width 1 m/3.3ft, min length 1.4m/4.6ft
Combined bathroom and water closet	Min size 1.8m2/19. 4sq.ft with a min width of 1 m/3.3ft.

The min clear height of bathrooms and water closet shall be 2.15m/7ft
Balcony and corridor:

Individual balcony with a unit Balcony	Min width 0.9m/3ft
serving more than one dwelling units	Min width 1.2m/4ft

Light and ventilation:
Every room, bathroom and kitchen shall have windows in an external wall opening on a courtyard, a balcony not wider than 2.5m or the exterior. The aggregate area of openings in the exterior wall of a habitable room or kitchen shall not be less than 12% of the floor area and that for a non- habitable room such as bath room, water closet or stair shall be at least 8% of the floor area.

9. Dwelling types according to BNBC and Income range:

Figure 6, Illustrated proposed Plan for different dwelling type according to BNBC and income group

Type	House hold Size	Income	Affordibility (30%)	Unit Size (Sq. Ft.)	Design
01	1-2	5000-13000	1500-3960	120+ shared 80 = 200	1 bedroom, 1 living & dining, shared services
02	3-4	5000-8500	1500-3960	200+60 = 260	1 bedroom, 1 living & dining, services
03	5-6	5000-8500	1500-2550	250+ shared 80 = 330	2 bedrooms, 1 living& dining, shared services
04	5-6	9000-13000	2700-3960	350+80 = 450	2 bedrooms, 1 living & dining, services
05	7-8	9000-13000	2700-3960	450+100 = 550	2 bedrooms, 1 living & dining, services

10. Conclusion

The study on the income status and the living patterns of the factory worker of the Ershadnagar, Tangi, Gazipur and Kabirpur of Savar will reveal the functional needs and existing condition in settlements of different types of workers. The living patterns found in the survey are organically development by the workers for satisfying the needs of various income groups. Worker of a certain income group cannot afford to have other housing types those are associated with higher income groups of workers. Moreover, the higher income worker group may need comparatively better housing environment and facilities. The scope of this study is to pave the way for the housing research initiative to develop more sustainable housing systems utilizing limited resources to satisfy housing needs for workers. In this regard the study can be assessed for future development or future planning of housing solutions for garments workers that can satisfy the diverse functions as required by various income groups.

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LIFE MANAGEMENT OF CONTRACTOR'S SITE QUANTITY SURVEYOR

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Abstract
Life management controls the quality of one's work while ensuring one's quality of life with minimum conflicts. The contractor's site quantity surveyor (QS), who has to shoulder many responsibilities on-site amongst time constraints, can most probably experience a life imbalance. Because the personal responsibilities of female and male site QSs differ, the aim of this study was to identify the strategies that will enhance the life management of contractor's site quantity surveyors. The qualitative approach was adopted in the study, and the required empirical data were collected by interviewing 20 females and 20 males contractor's site QSs. The interview findings were analysed using manual content analysis. Thirty-one and twenty-eight causes of life imbalance in male and female QSs respectively were identified. In addition, 50 and 48 strategies that will facilitate satisfactory life management in male and female QSs, respectively were identified. Some of the identified causes and strategies were common to both male and females QSs.

Keywords: *Life management, Contractor's site QS, Causes, Strategies*

1. Introduction

Life management helps one to maintain a flexible approach towards one's personal environment with minimum disturbance (Kotera, Green, and Sheffield, 2020). According to Bryne (2005), life management focuses on five important areas: work, family, friends, spiritual development, and health. For those who work in the industry, life management has become trendy and indispensable because it benefits them while also benefiting their businesses, and the society (Mas-Machuca, Berbegal-Mirabent and Alegre, 2016). Quantity surveyors (QS) are one of the key stakeholders of the construction industry (Lee and Cullen, 2018). The quantity surveying profession has changed over time and the quantity surveyors now have to bear high workloads, which are stressful to them (Abendroth, 2018). The construction industry being complex and risky, the QSs working in the industry find it difficult to maintain a life balance (Panojan, Perera and Dilakshan, 2019). Moreover, the roles of the male and female QSs in their jobs, families and personal lives differ (Bowen, et al., 2014; Gregory, et al., 2013). The life balance of QSs has already been explored in general. However, gender differences have to be considered when focusing on the life management of contractor's site QSs. Nevertheless, contractor's site QSs require special attention in these studies because they have to carry a huge workload at sites making life complex and stressful to them (Ashworth and Hogg, 2013). Therefore, life management of contractor's site QSs has to be studied for male and female QSs separately. Thus, the aim of this study was to investigate how the life management of contractor's site QSs can be improved. The objectives of the study were to identify the causes of life imbalance in male and female contractor's site QSs and propose strategies for their life management. Some of the causes are common to male and females QSs, while some are unique to either male or female QSs.

2. Quantity Surveyors in Construction

The construction industry encompasses a wide range of activities, products, and skills (George and Loosemore, 2019). Hence, the work capacity expected of a construction professional is high (Ochieng, 2015). Lingard and Francis (2006) highlighted that professionals working in the construction industry experience considerable work-related stress. The professional QSs in the construction industry have a huge responsibility to ensure that construction project costs remain within their estimated costs (Bowen, et al., 2014) because they are required to handle cost estimating, cost planning, cost controlling and reviewing, and contract administration (Mbachu, 2015). In the construction industry, a QS can work as a contractor QS, consultant QS or client QS (Ashworth and Hogg, 2013).

2.1 CONTRACTOR'S SITE Quantity Surveyors

The QSs in contracting organisations are attached to either the head office or a project site (Mbachu, 2015). George and Loosemore (2019) identified seven main tasks of contractor's site QSs: payment valuation; variation determination; allocation of preliminaries to elements; subcontractors' tender and actual cost evaluation; financial reporting; and cost accounting for material, plant, and workforce. The wide range of responsibilities they have to shoulder, time constraints, and the requirement to be constantly aware of site conditions cause stress in site QSs (Mas-Machuca, Berbegal-Mirabent and Alegre, 2016). Hence, a concept such as life management will be an ideal topic for discussion among contractor's site QSs.

3. Concept of Life Management

Life management establishes "the relationship between institutional and cultural times and spaces of work and non-work in societies where income is predominantly generated and distributed through labour markets" (Felstead, et al., 2002, p.57). According to Byrne (2005), life management has to focus on five aspects of life: work, family, friends, health, and spiritual activities. Thus, life management has to focus on these five areas. Through life balance, home and workplace satisfaction with minimum conflicts can be achieved (George and Loosemore, 2019). Paryani (2015) stated that family life involves taking care of family, children, parents, and health; and having effective leisure time. According to Holden and Sunindijo (2018), social life includes extra-curricular activities, such as sports, and visiting the gym and friends, and talking with the family. Paryani (2015) emphasized that poor physical and mental well-being causes unbalanced work and homework. Hence, as explained by Holden and Sunindijo (2018), having a healthy and strong body and mind set, is important for managing life. Paryani (2015) pointed out that spiritual peace enables to maintain a positive attitude towards work and life.

3.1 IMPORTANCE OF LIFE MANAGEMENT FOR FEMALE AND MALE CONTRACTOR'S SITE QUANTITY SURVEYORS

Van Eck and Burger (2019) disclosed that QSs play a significant role in the construction industry today. Lee and Cullen (2018) emphasized that contractor's site QSs have to bear huge responsibilities during project execution. Site employees, who are away from their families, have to comply with deadlines, manage staff and site operations, and engage in negotiations with other stakeholders and strive to resolve any disputes with them (Sajithkumar, 2014). The increasing levels of stress among QSs highlight the need for life management of QSs (Panojan, Perera and Dilakshan, 2019) working at sites. Heavy workloads; long working hours; job stress; poor working environments; poor health conditions; job insecurity; sleep deprivation; loss of control over work; incompetence; travelling and accommodation; risk and occupational hazards; poor salaries; poor rewards, compliments, and promotions; obsolete technologies; and domestic and family responsibilities were identified as the common causes of life imbalance in contractor's site QSs (Panojan, Perera and Dilakshan, 2019; Lingard, Francis and Turner, 2012; Sajithkumar, 2014; Gregory et al., 2013; George and Loosemore, 2019; Paryani, 2015; Holden and Sunindijo, 2018). Regular breaks/adequate sleep, flexible working hours, preparation of the day's program schedule early in the day, home working (E-working), job sharing and team work; work outs, helpful and understating partners, child adoption and fostering leave, dependency leave, regular vacations, self-evaluations, relaxing and amusing activities , positive mind sets will promote life balance in contractor's site QSs (Panojan, Perera and Dilakshan, 2019; Lingard, Francis and Turner, 2012; Sajithkumar, 2014; Gregory et al., 2013; George and Loosemore, 2019; Paryani, 2015; Holden and Sunindijo, 2018, Sunindijo and Kamardeen, 2017).

Even though most causes of life imbalance and strategies for life management are common to male and female QSs working for contractors at sites, Gregory et al. (2013) emphasized that the working environments of male and female construction professionals are based on the gender, and that

therefore different. Females have to fulfil their career obligations while shouldering family responsibilities (Panojan, Perera and Dilakshan, 2019). Sunindijo and Kamardeen in 2017 argued that compared with female professionals, male professionals hold senior positions in their workplaces and consequently they experience relatively more stress because of job risks and possible negative implications of any mistakes they make at work. Sunindijo and Kamardeen (2017) revealed that the causes and consequences of life imbalance in people differ according to gender. Therefore, the factors associated with life imbalance of contractor's site QSs will depend on the gender. Thus, life management of contractor's site QSs has to be studied for male and female QSs separately.

4. Research Methodology

The causes of life imbalance in contractor's site QSs and the strategies that will promote life management in them were identified from the literature. Gunnell (2016) identified that the qualitative approach can be used in a research where intangible evidence and non – numerical data have to be gathered. According to Creswell and Clark (2017), the qualitative approach involves developing questions, collecting data from relevant personnel, and analysing the collected data to obtain their real meanings. Therefore, a qualitative approach was adopted in this study. The required empirical data were collected through semi-structured interviews. The interviewees, 20 females and 20 male QSs in the age group of 25–40 years and holding varying designations, were selected using purposive sampling. The period between 25 and 40 years (in age) is the most challenging period in the life of a QSs owing to family responsibilities, and the focus on carrier development and qualification acquisition. The details of the interviewees are listed in Table 1. Interview findings were analysed using manual content analysis.

Table 10. Details of the Interviewees

ID	Designation	E	A	M	ID	Designation	E	A	M
F1	Project QS	4	29	Single	M1	Senior QS	10	35	M/C
F2	QS	3	29	M/NC	M2	QS	1	25	Single
F3	Senior QS	5	30	Single	M3	QS	1	26	Single
F4	Senior QS	14	40	M/C	M4	Cost Manager	4	40	M/NC
F5	Senior QS	7	31	Single	M5	QS	1	28	M/NC
F6	QS	3.5	29	M/NC	M6	QS	7	32	M/NC
F7	QS	4	30	Single	M7	Chief QS	10	34	Single
F8	Senior QS	8	34	Single	M8	QS	6	30	Single
F9	CA	5	31	Single	M9	Senior cost manager	4	29	M/NC
F10	Senior QS	11	34	M/C	M10	Lead Cost Controller	13	38	M/C
F11	QS	3.5	29	M/NC	M11	Project QS	5	30	M/C
F12	Senior QS	14	40	M/C	M12	Senior QS	4	29	Single
F13	Claim Engineer	5	29	M/NC	M13	Chief QS	10	34	Single
F14	QS	10	31	M/NC	M14	QS	7.5	27	Single
F15	Electrical Estimator	4.5	28	Single	M15	QS	7	32	Single
F16	Contract Manager	11	36	M/C	M16	QS	5.5	30	M/NC
F17	QS	4	29	M/NC	M17	CE	13	37	M/NC
F18	CA	7	32	M/NC	M18	Project QS	5	29	M/NC
F19	QS	4	29	M/NC	M19	Senior QS	5.5	29	M/NC
F20	QS	6	34	M/C	M20	Commercial manager	8	34	M/C

E - Experience, A - Age, M - Marital Status, M/NC - Married with no children, M/C - Married with children, QS - Quantity Surveyor, CA – Contract Administrator, CE – Construction Engineer

5. Findings and Analysis

5.1 CAUSES OF LIFE IMBALANCE IN CONTRACTOR'S SITE QS

Twenty-one and eleven causes of life imbalance in male contractor's site QSs were identified from the literature and by the interviewees, respectively. Similarly, for the female contractor's site QSs, 17 causes were identified from the literature, while 11 causes were identified by the interviewees. The 32 causes related to male QSs and the 28 causes related to female QSs are listed in Table 2 with the causes identified by the interviewees highlighted in bold.

Table 11. Causes of life imbalance in male and female contractor's site QSs

Causes of Life Imbalance in Male QSs	L	N	Causes of Life Imbalance in Female QSs	L	N
Heavy workload	√	19	Heavy workload	√	20
Job stress	√	19	Long working hours	√	20
Long working hours	√	18	Unrealistic deadlines	√	20
Family responsibilities	√	18	Domestic responsibilities	√	20
Poor management	√	18	Traveling and accommodation	√	18
Poor working environment	√	17	Risk and occupation hazards	√	17
Poor health	√	17	Poor working environment	√	17
Exhaustion	√	17	Poor health	√	16
Employers' last-minute expectations	√	16	Loss of control over work	√	16
Loss of control over work	√	16	Incompetency	√	16
Job insecurity	√	15	Job insecurity	√	15
Lack of sleep	√	15	Lack of sleep	√	14
Personal ambitions	√	15	Personal ambitions	√	14
Regular changes in working conditions	√	14	Lack of recognition through rewards, compliments, or promotions	√	14
Poor salary	√	12	Obsolete technologies	√	13
Risks and occupation hazards	√	12	Poor salary	√	13
Traveling and accommodation	√	12	Regular changes made to client's requirements	√	13
Lack of commitment	√	12	**Focus on higher studies or career development**	X	12
Lack of recognition through rewards, compliments, and promotion	√	11	**Not being up to date**	X	12
Incompetency	√	11	**Lack of proper office systems**	X	5
Obsolete technologies	√	8	**Lack of paid leave**	X	4
Poor interpersonal skills, teamwork, and self- confidence	X	8	**Lack of competent supporting staff**	X	3
Lack of paid leave	X	4	**Lack of commitment**	X	2
Incorrect decision making	X	2	**Lack of interpersonal skills, and self-confidence**	X	2
Competitive environment	X	2	**Lack of support from the family**	X	2
Dominating superiors	X	2	**Pursuit of perfectionism**	X	2
Self-centered objectives	X	2	**Too many responsibilities**	X	2
Time devoted to higher studies or career development	X	2	**Favoritism / Discrimination**	X	2
Addictions	X	1			
Non availability of profitable projects	X	1			
Salary delays / Non-	X	1			

Causes of Life Imbalance in Male QSs	L	N	Causes of Life Imbalance in Female QSs	L	N
payment of salary					
Favoritism / Discrimination	X	1			

**L – Found from the literature and N-Number of Interviewees who responded*

According to Panojan, Perera, and Dilakshan (2019), issues associated with travelling and accommodation are separately responsible for life imbalance in contractors' s site QSs. However, the interviewees were of the view that because travelling and accommodation are interrelated, they should be combined and considered as one factor. The heavy workload of contractor's site QSs was common to male and female QSs because it influences the quality of work, time available to the family, social engagements, and physical and mental well-being. The interviewees identified several additional causes of life imbalance, such as personal ambitions; poor interpersonal skills, teamwork, and self-confidence; lack of paid leave, that are common to male and female site QSs. Usually, males are the breadwinners of their families. Therefore, the financial stability of the family is one of the main concerns of a male. Thus, non-availability of profitable projects, delays in paying the salary or the non-payment of the salary, and self-centred objectives were identified as causes of life imbalance unique to male site QSs working for contractors. Sunindijo and Kamardeen (2017) identified that male professionals can be influenced by their superiors. Thus, dominating superiors was identified as a cause of life imbalance in male site QSs of the contractors. The causes such as incorrect decision making and competitive environment that are unique to males are a result of their authoritative nature of the superiors. Some causes such as unsupportive family and pursuit of perfectionism are unique to female QSs working in sites for contractors. According to the interviewees, these factors are a result of the unique role played by females at home. Gregory et al. (2013) also have stated that the differences between the factors that cause life imbalance in males and females could be due to the specific roles that females play at their homes. The failure to be up to date, lack of proper office systems, lack of competent supporting staff, and too many responsibilities can cause life imbalance in female site QSs of contractors.

5.2 STRATEGIES TO MANAGE THE LIFE IMBALANCE OF CONTRACTOR'S SITE QS

Eighteen and thirty-two strategies were identified from the literature and interviews, respectively for life management of site male QSs of contractors. Similarly, 18 and 30 strategies for life management of site female QSs of contractors were identified from the literature and interviews, respectively. All the strategies are listed in Table 3 with those identified from the interviews indicated in bold.

Table 12. Strategies to overcome life imbalance of contractor's site QSs

Strategies for Male QSs	L	R	Strategies for Female QSs	L	R
Having regular breaks/adequate sleep	√	20	Having regular breaks/adequate sleep	√	20
Arranging flexible working hours	√	20	Arranging flexible working hours	√	20
Preparing a program at the beginning of the day	√	20	Preparing a program at the beginning of the day	√	20
Home working (E working)	√	20	Home working (E working)	√	20
Job sharing and teamwork	√	20	Giving advance notice about overtime work	√	20
Granting paternity leave	√	20	Arranging women only courses	√	20
Offering rewards and compliments	√	20	Offering rewards and compliments	√	20
Doing workouts for physical well-being	√	20	Granting extended maternity leave	√	20
Getting helpful and understating partners	√	20	Job sharing and teamwork	√	20
Granting child adoption and fostering leave	√	20	Doing work outs for physical well-being	√	20
Granting dependency leave	√	20	Take caring of children with the assistance of the spouse	√	20

Strategies for Male QSs	L	R	Strategies for Female QSs	L	R
Take continuous vacation / break from the work	√	20	Granting child adoption and fostering leave	√	20
Conducting self-evaluation	√	20	Granting dependency leave	√	20
Obtaining the services of family advocates	√	20	Take continuous vacation / break from the work	√	20
Maintaining a daily diary	√	20	Working on shifts	√	20
Engaging in relaxing and amusing activities	√	20	Thinking positively	√	20
Thinking positively	√	20	Engaging in relaxing and amusing activities	√	20
Selecting jobs carefully	X	18	**Conducting self-evaluation**	√	20
Managing work proactively	X	17	**Introducing new technologies**	X	19
Working smartly	X	17	**Managing work proactively**	X	19
Using convenient travelling facilities or finding accommodation close to the site	X	17	**Developing competencies through lifelong learning**	X	19
Arranging interactive communication platforms	X	17	**Working smartly**	X	19
Introducing new technologies	X	16	**Declining to accept unrealistic deadlines and working with competency**	X	19
Developing competencies through lifelong learning	X	15	**Being content and maintaining positive attitudes**	X	19
Declining to accept unrealistic deadlines and working with competence	X	15	**Getting the employer to provide reliable day-care services that can be monitored online**	X	16
Allocating work to a suitable team, and monitoring and supporting the team as required	X	15	**Arranging company system updates**	X	15
Focusing on the work	X	14	**Allocating work to a suitable team, and monitoring and supporting the team as required**	X	15
Grabbing new opportunities	X	13	**Having an aesthetically pleasing and clean working environment**	X	14
Arranging company system updates	X	13	**Having a proactive leadership**	X	14
Encouraging site safety among the workers and employees	X	13	**Working with commitment**	X	14
Working effectively and efficiently	X	12	**Maintaining improved communication**	X	14
Offering a salary commensurate with the work	X	12	**Adhering to stipulated safety standards**	X	14
Offering festival bonus	X	11	**Arranging organisational recreational activities**	X	13
Investing part of the savings	X	10	**Using convenient travelling facilities**	X	12
Taking care of children with the assistance of the spouse	√	10	**Arranging health schemes**	X	12
Having an aesthetically pleasing and clean working environment	X	10	**Offering a salary commensurate with the work**	X	11
Arranging organisational recreational activities	X	9	**Selecting jobs carefully**	X	10
Having affordable private goals	X	9	**Inquiring from the employer about the salary in advance and marketing oneself**	X	10
Conducting project management during pre-contract stage	X	8	**Granting festival bonus**	X	10
Conducting individual risk assessment	X	8	**Focusing on the work**	X	9
Having a proactive leadership	X	7	**Offering salary increments based on performance**	X	9
Having a proper IT & R&D	X	5	**Conducting project**	X	6

Strategies for Male QSs	L	R	Strategies for Female QSs	L	R
division in the working place			**management during pre-contract stage**		
Maintaining a high standard of professionalism	X	5	**Having rest rooms**	X	5
Inquiring from the employer about the salary in advance and marketing oneself	X	4	**Having a flexible program (Floating between tasks)**	X	4
Offering salary increments based on performance	X	4	**Having yearly reviews with the superiors**	X	3
Liaising with the employer/management about the resource requirements	X	4	**Arranging a health and safety insurance cover**	X	3
Informing the management about the lack of competent employees / subordinates	X	2	**Using a time management app**	X	1
Having peaceful surroundings with huge paintings of light colours	X	1	**Maintaining updated master documents**	X	1
Having yearly reviews with the superiors	X	1			
Keeping a record of the orders given	X	1			

**L – Found from Literature and N-Number of Interviewees responded*

From the interviews, a set of strategies that can be adopted for life management of male and female site QSs were determined. Managing work proactively, prioritizing the work, planning the work, and adapting smart and effective approaches can be the strategies for handling heavy workloads and rigid time frames. Similarly, developing competencies through lifelong learning, working with commitment, arranging organisational recreational activities, granting festival bonus, arranging company system updates, maintaining a clean and comfortable working environment, conducting project management during pre-contract stage, having yearly reviews with the superiors, and declining to accept unrealistic deadlines and working with competency were identified as the strategies that will help manage life imbalance of both male and female site QSs working for contractors.

As stated by Sunindijo and Kamardeen (2017), conducting individual risk assessment was introduced by the interviewees as a strategy for the life management of male contractor's site QSs because of their exposure to various risks. As an extension of this strategy, obtaining a health and safety insurance cover was identified as a strategy for the life management of female site QSs of contractors because even females are exposed to risks and hazards. Several strategies, such as grabbing new opportunities, having affordable private goals, inquiring from the employer about the salary in advance, and investing part of the savings were identified as strategies unique for the life management of male QSs' working at sites for contractors, males being the breadwinners of families. As stated by Sunindijo and Kamardeen (2017) as well, keeping a record of the orders given and maintaining a high standard of professionalism are strategies that can be adopted for the life management of male QSs holding senior positions and working at sites for contractors. Being content and maintaining positive attitudes, getting the employer to provide reliable day-care services that can be monitored online, and having restrooms are suggested as strategies unique to handling life management of female site QSs working for contractors. Maintaining updated master documents was introduced as an important practice by a female site QS, because it avoids stress arising from mistakes and errors that occur when working with many documents.

6. Conclusions and Recommendations

The contractor's site QS is a major stakeholder of a construction project, who has to shoulder many responsibilities. Hence, the contractor's site QSs experience life imbalance. According to the study findings, addictions, non-availability of profitable projects, delays in the payment of salaries or non-payment of salaries, incorrect decision making, competitive environment, and having self-centred objectives were identified by the interviewees as distinctive causes of life imbalance in the male site

QSs working for contractors. Unsupportive family and pursuit of perfectionism, which are two distinctive causes of life imbalance in female site QSs working for contractors, should be given due attention by female site QSs. Life imbalance of site QSs of contractors can arise because of their incapability; influence of staff, peers, and superiors; organisational practices; and cultural and social factors. Incapability can be overcome by carefully selecting jobs, developing knowledge and competencies, taking care of one's health, and proactively managing time. Implications of organisational practices can be managed through proactively managing work, arranging company system updates, introducing new technologies, and maintaining an appropriate working environment. Several strategies, such as being content and maintaining positive attitudes, getting the employer to provide reliable day-care services with the facility to monitor online, and having restrooms, that are unique for overcoming life imbalance of female site QSs of contractors were also revealed in the study. The causes of life imbalance in contractor's site QSs and strategies that can be adopted to overcome the imbalance differ according to the gender. Thus, the study findings will help create an efficient and effective working environment for both the male and female site QSs working for contractors.

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PRODUCT PERSONALIZATION: STIMULATING ATTACHMENT BETWEEN PRODUCT AND CONSUMERS

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Abstract

This study investigates about how product personalization can be used to stimulate attachment between products and Sri Lankan consumers. Through the literature it was evident that, consumer involvement and the final personalized product, in product personalization can act as the main sources which evoke positive emotions, through self-expression, enjoyment and memories, to stimulate attachment. Three hypothetical scenarios of product personalization followed by online questionnaires about the experience were created to verify these findings of literature. The feeling of attachment was evident towards these personalized products as discovered through literature, especially in the responses of female participants. It was also evident that they would most likely to protect and use the product for a longer time than male participants. Several methods providing personalization options to stimulate long term attachment were identified together with the literature and primary data. Additionally, providing adequate options to personalize the product to their satisfaction, requirement of less technical knowledge in personalization process and already having a need of personalizing the primary functionality of the product were identified to be promoting the feeling of attachment.

Keywords: *Product personalization, Attachment, Emotional bond*

1. Introduction

Rapidly developing technology has created a new "throwaway culture" (Page, 2014). Perfectly functioning products are quickly becoming obsolete (Fels et al., 2017). Consumers lose the interest on the available product soon as a new model develops. This is evident in most technology-based products such as laptops, smartphones, vehicles etc. While thrown away products cause pollution, replacement of scarce resources which are used up during production in forms of material and energy, effects the environment. This will create a huge impact on the already polluted environment. But according to the studies of Mugge (2007), when a consumer experience a strong attachment with a product, they are more likely to care, repair and postpone its replacement, increasing its ownership time.

Studies of Mugge et. al (2009) identified product personalization as a potential design strategy which could be used stimulates attachment with the product. Therefore, knowledge on how product personalization stimulates attachment can be used to design products which have longer life time, supporting for an environmentally friendly future.

2. Identification on the Relationship between Attachment and Product Personalization

A literature study was carried out in order to identify what attachment is and how consumers gets attached towards products, to form a theoretical base on about how attachment is stimulated by product personalization.

2.1 PRODUCT ATTACHMENT

Related to interpersonal relationships, based on the studies of the British psychologist John Bowlby, attachment is defined as an emotional-laden target-specific bond between two persons (Mugge et al. 2010). Similarly, product attachment has been defined as the emotional bond and feelings that connect a consumer with a product (Park and Yoo, 2018).

According to Ko et al. (2015), attachment occurs when there is a strong commitment and emotions towards a product. These consumers tend to invest a great deal of psychic and emotional energy on these products (Schultz et al, 1989). They cherish this relationship and would exhibit more protective

behaviour (Mugge, 2007), would repair them if they are damaged and would gain some enjoyment from doing this as well (Page, 2014). According to Mugge et al. (2008) consumers identify these products as extraordinary and favourites. They are considered as irreplaceable, indispensable products and these consumers will try to keep hanging on to them increasing the product lifetime (Schifferstein and Zwartkruis-Pelgrim 2008). Therefore, product attachment can be defined as an emotional connection that consumer feels with a product, which increases the personal value of it.

2.2 DETERMINANTS OF ATTACHMENT

Several studies were conducted by scholars to identify about the determinants which cause attachment. Mugge (2007) identified self-expression (expresses the unique identity of the consumer), group affiliation (expresses the consumer's belongingness to a group), memories (reminds of the past) and pleasure as determinants of product attachment to ordinary durables. Schifferstein and Zawarkruis-Pelgrim (2008) identified seven possible determinants of attachment: self-identity, enjoyment, memories to persons, places, and events, life vision, utility, reliability, market value and out of them, they identified that memories and enjoyment as positively contributing to the degree of attachment. Memories, pleasure, usability, reliability and the trust in the product were identified as causes of attachment by Page (2014). Out of them memories and pleasure were identified as primary causes. Self-expression can be categorized as expressing private self and expressing public self (Mugge et al, 2006, Schultz, 1989). Therefore group affiliation (expressing public self) can be included to the category of self- expression. Based on these studies, self-expression, enjoyment and memories can be identified as prominent determinants of attachment.

2.3 STIMULATION OF ATTACHMENT THROUGH PRODUCT PERSONALIZATION

As defined by Blom (2000), "product personalization is defined as a process that defines or changes the appearance or functionality of a product to increase its personal relevance to an individual" (Mugge et. al 2009, p. 468). Personalized products meet specific needs and express the unique tastes and preferences of the consumer (Kudus, 2017). Therefore these products can function and look exact the way which consumer wants.

For a product to be personalized to meet the exact individual requirements of the consumer, some involvement of the consumer is required. The designer should offer more decision-making power to the consumer, to operate as co-designers. Therefore, in addition to the designing of the product, the designer should design the process of personalization.

2.3.1 Relationship between Attachment and Emotions

Attachment between a consumer and product implies the existence of an emotional tie between the consumer and the product. (Schifferstein and Zwartkruis-Pelgrim, 2008) But, association of emotions doesn't always suggest the presence of product attachment. On interpersonal relationships it was explained that individuals are securely attached when they are experiencing positive emotions (Simpson et al, 2007). Similarly, Mugge et al. (2008) explains that despite of huge variety of emotions, people often experience attachment to products, when positive emotions are involved.

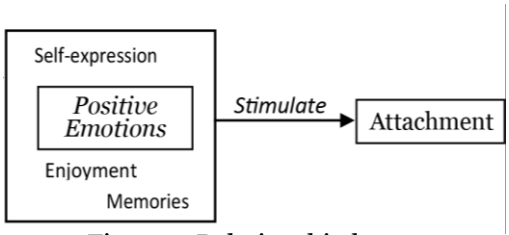

Figure 1: Relationship between Attachment and Emotions
Source: (By Author)

As explained previously attachment was also found to be caused by the determinants; self- expression, enjoyment and memories. These determinants have the ability to evoke positive emotions (Mugge et al., 2008). Therefore as shown in figure 1 positive emotions caused by determinants of attachment are responsible in stimulating attachment between the consumer and the product.

2.3.2 Relationship between Product Personalization and Emotions

Emotions are always a response to a stimulus which has a personal relevance (Destmet, 2012). There is a cause for each emotion (Desmet, 2018). For example, happiness can be evoked by a product which performs better than expected. Related to human- product interactions, Desmet (2012) identified six basic sources of positive emotions; Emotions could be evoked in,

- Response to the material qualities of the object (ex: fascination provided by a well-designed product).
- Meaning of the object.
- Interaction with the object (ex: admiration provided when opening a wine bottle smoothly and effortlessly).
- Activity that is facilitated by this interaction (ex: sense of relaxation and freedom provided when riding a motorcycle through the fields, with wind and sun).
- By the self (ex: confidence felt when wearing comfortable shoes).
- Others involved in the interaction (ex: feeling of love when receiving a gift from a special person).

Therefore in product personalization, the consumer involvement as well as the final personalized product can act as main sources which stimulate emotions as in the figure 2.

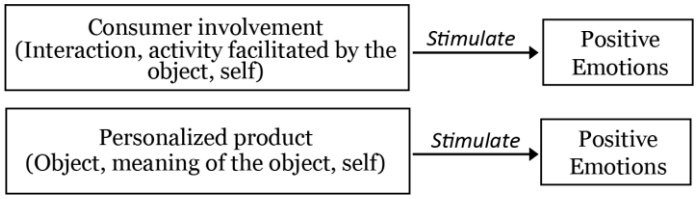

Figure 2: Relationship between Product Personalization and Emotions
Source: (By Author)

2.3.3 Relationship between Product Personalization and Attachment

Several scholars have identified product personalization as a potential method of forming attachment (Mugge, 2007; Mugge et al, 2008; Page 2014). As discovered through the literature in the previous sections, in product personalization, consumer involvement and the final personalized product can act as the main sources which evoke positive emotions, through self-expression, enjoyment and memories, to stimulate attachment (Figure 3)

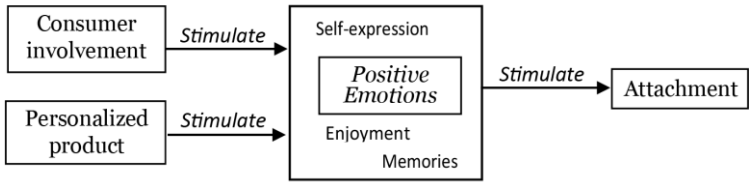

Figure 3: Conceptual model on relationship between Product Personalization and Attachment
Source: (By Author)

3. Research methodology

The study was conducted by initially allowing the respondents to participate in hypothetical scenarios to personalize the 3 types (as explained in section 3.2) of products according to the way they like, using a given set of options, in different stages of the product's lifetime.

Three products were selected as stimuli, to generalize the responses regardless of the product type. Based on this experience of product personalization both quantitative and qualitative data were collected, to identify how attachment is stimulated through product personalization, for Sri Lankan consumers. For this, a questionnaire was prepared with both close ended and open ended questions to confirm findings of literature and to gather new data.

3.1 SAMPLE SELECTION

For this study, male and female participants of age group 21-25 were chosen based on following reasons; This is a stage of life where individuals starts becoming free from parental familial school restrains they felt during childhood (Center on media and child health, n.d). Currently, involving the consumer in the personalization process is not a common practice for most products in Sri Lanka. At the selected age, individuals start to question the experiences, beliefs from childhood and become more willing to compromise and restructure them (State adolescent health resource center, n.d.). Therefore it is easier to adapt to new practices. Within this age group, for the current study the category, Sri Lankan students of government universities were selected because they have a large representation and exposure to individuals from different cultures, races, different socio-economic backgrounds around Sri Lanka.

3.2 PRODUCT SELECTION

Three tangible, functional, commonly used product categories which are commonly bought for personal usage of the general population of the selected sample were selected as stimuli for the study.

a) Umbrella- a product which doesn't usually need changes in its primary functionality (weather protection) while using.
b) Backpack- a product which usually needs its primary functionality (store and transport) to be change while using, depending on what is stored and transported.
c) Smartphone- a product which usually needs its primary functionality (communication and entertainment) to be changed based on upgrades of the technology

4. Research Findings and Discussions

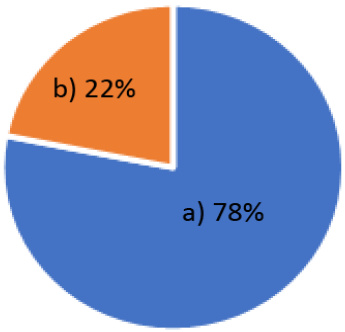

Figure 4: Preference in buying (a) personalized vs (b) ready-made product.
Source: (By Author)

A total of 128 participants (63 male and 65 female) completed the questionnaires related to umbrella, backpack and smartphone. 41 completed the questionnaire related umbrella (22 male and 19 female), 45 completed the questionnaire related to the backpack (20 male and 25 female) while 42 completed the questionnaire related to the smartphone (21 male and 21 female). Out of all these respondents, 78% preferred to buy a personalized product rather than ready-made product (Figure 4). Therefore, it could be concluded that majority Sri Lankan consumers prefer personalized products over ready made products.

4.1 FEELING OF ATTACHMENT

Respondents were given with the option of selecting “yes”, “no” or “maybe” to identify whether they would feel a sense of attachment to the product which they personalized. Option “maybe” was given to filter out the responses of doubt.

60.9% of all the respondents identified that they would definitely feel a sense of attachment to personalized products (50.7% of male, 70.7% of female respondents). 3.1% of all respondents identified that they wouldn’t feel a sense of attachment towards the product. As commented by some participants less usage of the type of product given in real life and dis-likeness for the available products in the category and feeling of highly negative emotions such as frustration by personalizing their own product are possible reasons for this. 33.6% of participants were unable to determine whether the product would create a sense of attachment or not. Use of a hypothetical scenario of personalization about a product/process they have not yet experienced is a possible reason for this result

Based on these data it could be concluded that product personalization can have an effect on the feeling of attachment, as discovered through literature. Furthermore, it appears to be more prominent among female participants than male participants.

4.2 REASONS FOR THE FEELING OF ATTACHMENT

Out of all the respondents who felt a sense of attachment after participating in the hypothetical scenario of personalizing the products, 65% felt that the final product express about their-selves and 58% enjoyed participation. 96% felt either one of them.

As it was evident from the qualitative data of the questionnaire survey, the participants identified several factors as the reasons of the feeling of attachment towards the personalized products;

- The final product express, represent the consumers’ identity and self- interests.
- Personal achievement accomplished by the consumers’ own ideas and will.
- Unique product which is specially made to match the requirements of the user.
- Unique experience.

When considering about the number of participants who identified that they would feel attachment towards each product; 64% identified that they would feel attachment towards backpack, 61% towards umbrella and 57% towards smartphone. When considering the results of umbrella, it was the personalization processes enjoyed by least number of respondents, out of these 3 products. But majority felt it would express their-selves (72%) than other two products. Enjoyment being least experienced in the personalization of umbrella could be a reason for it not being the product which stimulated attachment to most number of participants (compared to backpack). Therefore, even though self-expression is more recognized by consumers as a reason which stimulates attachment, it could be observed that enjoyment is important as well in product personalization. as explained by the literature.

Through the qualitative data, it was observed that many identified that they already have a greater need of personalizing the functionality of the backpack while using the product; Such as changing the pocket sizes of the bag according to the situation, changing strap lengths according to the weight of the bag. As shown in Table 1 this could be a reason why majority felt attachment towards backpack, than other products.

Table 1- Identification on Presence of Determinants of Attachment

	Umbrella (%)	Backpack (%)	Smartphone (%)
(i) Self expression	72	69	54
(ii) Enjoyment	52	62	58
(iii) Doesn't feel any of above	8	0	17
Feeling of attachment	61	64	57

Source: (By Author)

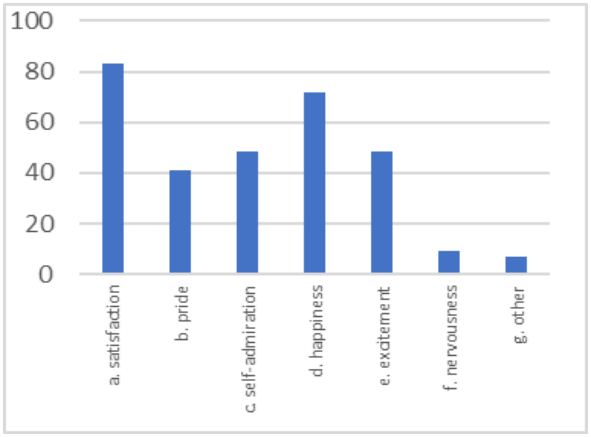

Figure 5: Emotions felt from involving in the personalization process.
Source: (By Author)

4.3 EMOTIONS FELT BY PRODUCT PERSONALIZATION

From the literature, it was evident that, attachment was felt as a result of stimulation of positive emotions. Confirming this, positive emotions; satisfaction (83%), happiness (71%), excitement (49%), self-admiration (49%), pride (41%), freedom, comfort, confidence and fun were identified as emotions felt from involving in the personalization process by the participants felt a sense of attachment (Figure 5). The negative emotion frustration was evident in some of the responses of respondents who identified that they won't feel a sense of attachment

Additionally, based on the current study even though the nervousness can be considered as a negative emotion (felt by 9% of participants who felt attachment), it could be concluded that negative emotions doesn't necessarily stimulate detachment, due to the dominance of other positive emotions.

4.4 RESULTS OF ATTACHMENT IN PRODUCT PERSONALIZATION

Through the literature study about products which users felt attachment, it was evident that attachment could increase the product's lifetime. But in the current study, 44% of the participants responded that they would protect it and 32% identified that they would repair and try hanging on to it if gets broken and only 19% identified that it is irreplaceable. Therefore it could be concluded that the attachment felt is short term. Confidence they developed; that they can built a similar product on their own again is a possible reason for this.

5. Implications

When the consumer actively participates in the process of personalization, consumers perceive the product as better fit to their preferences. During the process of personalization, if the process provides adequate options to personalize the product in the way consumer needs, it has the ability to evoke positive emotions such as satisfaction and happiness, which were observed to be the emotions most commonly felt by those who felt attachment in the case studies.

Figure 6: Hells Angels biker gang-
Public self-expression
Source: (https://www.rideapart.com/
articles/253619/)

As these products are created by the consumers to fit their preferences, they express about themselves (private self), about their unique identity. Hence, they evoke emotions such as confidence, pride, and admiration related to the self. If this personalization process is executed in the presence of a group or if the final product symbolizes belongingness to a group, these products define and maintain the public self of the consumer. Therefore they can stimulate attachment via group affiliation. Harley Davidson motorcycle is an example for a product which stimulates attachment through product personalization, to some of its users through public self-expression (Figure 6). Emotions evoked due to self-expression in the personalized product last as long as the product, unless the consumers' personal preferences of self-expression changes.

As it was evident from literature, products can arouse enjoyment by satisfying senses simultaneously through superior appearance, superior functionality and through familiarity and surprise (Schifferstein and Zawarkruis-Pelgrim, 2008). Products need to provide something special and more than the expected primary functions to stimulate attachment through pleasure(Mugge et al, 2008). From the primary data, participants identified unique experience gained by personalizing their own product as a reason for the feeling of attachment. This experience can be more enhanced by designing it so that it satisfies all senses harmoniously, providing familiar and surprising activities. Here, attachment could also be stimulated by providing an appearance of ease (by providing a process which could easily be understood by the knowledge of the consumer), comfort and safety at the process of personalization. After the final product is created, the emotions can be evoked by the object because it is made according to the preferences of the consumer such as; favourite colours and shapes.

Enjoyment through a surprising final outcome could be stimulated by providing personalization option to change the product while using product.

After involving in the process, the respondents who mostly sensed the presence of attachment were observed to be female (70.7%) against the males (50.7%). Also, considerable difference was observed among the female and male participants in feeling of happiness (Female-85%, Male- 53%) and feeling of enjoyment (Female-65%, Male- 46%). Biological differences as well as cultural, social and educational factors between men and women can trigger different behaviours and sensory perceptions. According to the studies of Walcher et al (2016), male brains have intensified one-sided processes while females utilize both sides of the brain in thinking. Purchasing processes of men are identified as straight forward and linear. They mostly consider about the utilitarian value. Whereas women's purchasing process is more complex and they are trying to find the perfect solution. They tend to consider about expressive or symbolic value (Walcher et al, 2016). When a ready-made product is bought, they are often not the perfect solutions which women seek. But by providing personalization facility, they can create the product according to the exact way they want. This could be a main reason for the difference between the results, in feeling of attachment, of female and male participants. More research is required on identifying how to increase the feeling happiness, enjoyment for male consumers, to stimulate the feeling of attachment through product personalization.

As it can be seen from the figure 7, it can be observed that more female participants felt that the personalized product is irreplaceable (26%), than it is felt by the male participants (9%). Due to this it can be observed that many of female participants identified that they would protect it and would try to keep hanging on to it by repairing it (50%, 36%), than the male participants (34%, 25%).

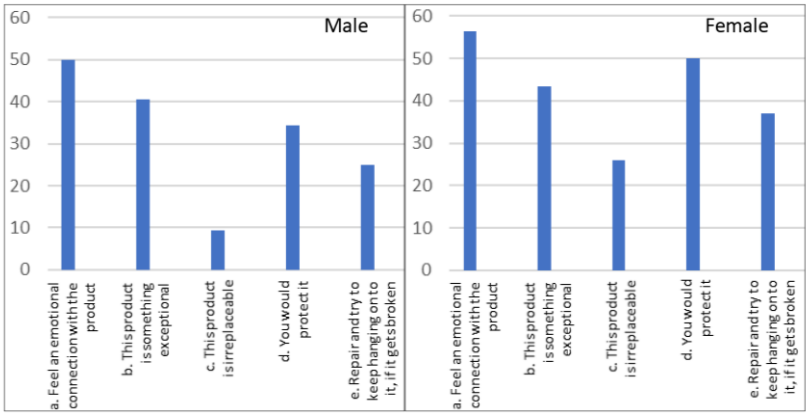

Figure 7: Variations in Results of Feeling of Attachment towards Personalized Products, Based on the Gender
Source: (By Author)

But when considering the overall number of participants, in the current study, the product was not irreplaceable for a majority and attachment felt was short term. Confidence they developed; that they can built a similar product on their own again was identified as a possible reason through this study. But, there are few possible ways to make a personalized product irreplaceable.

A product will get irreplaceable if special memories get associated with it. Then, even if the product gets broken, even they have the ability to remake a similar product, many would try to repair and would try to keep hanging on to the product with special memories, lengthening its lifetime. Memories are subjective of the users' experience with the product. Even though it is somewhat beyond the control of the designer, products can be made to retain important memories by designing them to 'age

with dignity', to retain marks of usage or by integrating specific odours during the personalization process or the final product so that they acts as trigger points to retain and remind certain memories (Mugge et al, 2008, Mugge, 2007). It is also possible to stimulate long term attachment by making each process of personalization more memorable and unique. Association of special people in the process of personalization also could create special memories.

Studies of Mugge et al (2009) identified mental/physical effort as a factor which promotes attachment. Therefore by designing the personalization process that requires mental/physical effort, which constantly remind the user of his/her personal achievement can stimulate long term attachment as well. But this personalization process should have a balance between complexity (evoke accomplishment, pride) and should be within the knowledge of the consumer (avoid negative emotions such as frustration).

6. Conclusions

Findings of the research explore how product personalization can stimulate attachment to the products used by Sri Lankan consumers. Happiness felt due to ease of understanding the process, satisfaction evoked by the idea of making a product suited to the users' preference, confidence and personal accomplishment felt due to being able to personalize the product on their own, fascination felt about the personalized product were some of the emotions identified. These emotions were identified to be evoked as a result of the determinants self-expression, enjoyment and memories. Through these empirical data, it was evident that consumer involvement in the personalization process as well as the final personalized product has the ability to stimulate positive emotions which stimulates attachment for Sri Lankan consumers, as conceptualized based on the literature. But significant differences were identified, in related to this feeling of attachment through product personalization, between the female and male participants.

Based on these data, implications on how these determinants could be optimized to enhance the feeling of attachment with associated with product personalization were identified. Further investigation on how to design the personalization process which stimulates long term attachment, especially for male consumers would be beneficial to design products which would aid in a sustainable future.

7. Acknowledgement

The success of this research required a lot of assistance and guidance from many, who I owe a great thanks to. My sincere gratitude goes to my research supervisor, Senior lecturer Mrs. Dilshani Ranasinghe, Department of Integrated design, for the guidance and immense support provided, senior lecturer Mrs. Melanie Dissanayake, Dr. Sumanthri Samarawickrama and Dr. Pradeep Peiris for providing all the necessary information and guidance in developing a successful research. My special thanks goes to all the participants of the research, for the assistance provided by spending their valuable time.

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INCORPORATION OF CIRCULAR ECONOMY CONCEPT TO THE APPAREL INDUSTRY: LITERATURE REVIEW

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Abstract
The apparel industry is one the most foreign exchange earning industries for developing countries. However, it is one of the notable polluting industries in the world too. Additionally, there are numerous factors affecting the economy of the industry, for example COVID 19, and the industry needs to reinvent from those issues by forcing itself to live. Thus, Circular Economy (CE) can act as a potential solution to address the issues related to both environmental and economic factors of the apparel industry. CE is a business strategy to gain economic benefit, minimise environmental impacts and increase the efficiency of resource consumption. CE concept has been practised in various countries such as China, Bangladesh, Europe, Australia and Germany. However, it is still a novel concept in Sri Lanka even though Sri Lankan apparel industry has a solid reputation globally for their high-quality, reliability, lead time, and social accountability. Introducing the CE concept into Sri Lankan apparel industry will help to overcome the financial issues in a sustainable way. With the intention of introducing CE concept to Sri Lankan apparel industry, this paper intends to review the application of CE in global context and in the context of apparel industry, their benefits and challenges in order to further investigate the suitability of CE concept to SL apparel industry. This paper is therefore based on a comprehensive literature review. Hence, it highlights the literature findings on the applicability of CE in apparel industry, its benefits and challenges when adopting CE into apparel industry. This basic finding will aid to assess the possibility of incorporating CE concept within the Sri Lankan apparel industry. The key findings of the research, environmental gain, economic benefit, resource optimisation and collaboration among stakeholders are the key benefits of CE. The main challenges are expensive, advanced technology, measuring the benefits especially financially, lack of support, knowledge, awareness, commitment and leadership, systematic regulation, social and cultural acceptance.

Keywords: *Circular Economy, Apparel Industry, Challenges, Benefits*

1. Introduction

The ability to produce apparel at extremely low cost has allowed the apparel industry to grow into a trillion-dollar industry, now one of the largest globally (Allwood, et al., 2006). It has experienced extensive growth and success over the last two decades and also the most significant and dynamic contributor to the national economy of developing countries (EDB, 2020). This has led to an intense scrutiny over economic, environmental, and social impacts within the industry. The apparel industry has specific negative impacts on the environment through all stages of the apparel product life cycle, from fiber growth and manufacturing, dyeing and printing, transportation to stores and selling, to end of the garment life disposal (Allwood, et al., 2006; Shaw, et al., 2006; Gam & Banning, 2011; Fulton & Lee, 2010). The Earth cannot indefinitely support the current level of production and disposal of apparel due to depletion of natural resources and quickly filling landfills (Claudio, 2007; Walker, 2008; Winge, 2008). Along with that, the attention in sustainable and eco-friendly products has started to increase globally (Muthukumarana, et al., 2017).

CE is a fresh economic model in contrast to the linear economic model, adapted by China at first. CE initiatives happen in global level (Ghisellini et al., 2016). The ultimate aim of CE is to achieve the decoupling of economic growth from natural resource depletion and environmental degradation (Liu, 2009; Xue et al. 2010), to keep the maximum level utility and value of the products and materials, through design, maintenance, repair, reuse, remanufacturing, and recycling and decreasing waste (Merli, et al., 2018). CE is a regenerative structure in such a way that resource input waste, emission, and energy use are minimised by closed loops of material and energy (Geissdoerfer, et al., 2017). The conversion of CE from a linear economy requires organisations to redesign their supply chain. Thus, CE is effective to promote to the green supply chain from the traditional chain (Zhu, et al., 2010). Also, in CE, a need to propose a business strategy raised to gain economic benefit, minimise environmental impacts and increase the efficiency of resource consumption (Zhu & Sarkis, 2006; Lai, et al., 2011). It is CE that further strengthens the consciousness of resource conservation and environmental protection (Ying & Li-Jun, 2012). Moreover, CE highlights protecting the environment and conserving the resource, thus, it is important to go beyond green manufacturing to GSCM.

Meanwhile, the apparel industries have started to fight for its survival due to COVID-19 (Echelon Media, 2020). For example, in Sri Lanka roughly 1.5 billion American dollar loss is expected in export incomes in the quarter of April-June 2020, while bracing for a 50% drop in demand for the next one to one and a half years (Sukumaran , 2020). Therefore, the industry should be in a position to reinvent by forcing itself to live (Echelon Media, 2020). Thus, CE could be a sustainable way to overcome this phenomenon. Accordingly, this is the best time to introduce the Circular Economy concept into apparel industry to overcome the economic issues in a sustainable way. The next section presents the methodology adopted for this paper followed by introduction, need and application of CE in the context of apparel industry. Further it discusses the benefits and challenges of adopting CE concept within apparel industry. The conclusions and way forward are finally presented.

2. Research method

This research paper was developed based on a comprehensive literature review and synthesis on the CE concept, its significance and the reported evidences on the incorporation of CE within apparel industry. It further reviewed the benefits and challenges associated with the adoption of CE concept. Conducting literature review is facilitating to initiate the research process when carrying out a research work. In a research, literature synthesis is a significant portion and according to Wilding, et al., (2012), a literature review is a systematic, explicit, and reproducible design for identifying, evaluating and interpreting the existing body of recorded documents" and further literature review is defined as primarily qualitative synthesis of results (Fink, 2005). Hence this paper adopts the literature review as the main methodology to present the research findings.

The literature search operation was facilitated by using a combination of keywords such as 'Circular Economy', 'Circular economy & Apparel industry', "Circular economy" & "Textile industry", and 'Benefits and challenges of CE'. The key journal articles published within last 10 years were mainly searched using main databases such as Google scholar, Emerald, Science Direct, Springer, etc. A total of 69 articles was selected after the first round of filtration, which involved scanning article titles for relevancy. The second round filtration was done to further refine the set of articles by reading the abstracts and conclusions, which resulted in 57 papers. While reviewing the full papers, 5 of the papers were found as not appropriate. Hence, 52 papers were finally identified to develop this literature review based paper.

3. Literature Synthesis

This section discusses the key literature findings of the study in four sub sections such as introduction to CE, need for CE in apparel industry, application of CE in apparel industry and benefits and challenges of adopting CE.

3.1. INTRODUCTION TO CIRCULAR ECONOMY

CE has both linguistic and descriptive meaning. The linguistic meaning of CE is an antonym of a linear economy (Murray, et al., 2017). Linear economy is a straight-line process; 'take-make-dispose' approach (open loop) with energy flow model whereas the CE is a cyclical approach (closed loop) with alternative flow model where wastes become resources (Gregson, et al., 2015; Braungart & McDonough, 2002). Even though, Linear economy is expected to have unlimited resources and energy for usage and also bulk environment to absorb the discharged waste and pollution, CE is idealised for reduction in the amount of energy and raw material usage with less waste generation (Cooper, 1999). Primarily, linear economy is an unsustainable economic system and it has dominated the overall development causing serious environmental harm, but on the other hand, CE is a sustainable economic system (Ellen Macarthur Foundation, 2014). Moreover, CE is based on natural laws which following natural cycle (Twigger, 2016), and four principles such as natural resource preservation, resource optimisation, risk reduction and renewable flow of resources and products (Gullingsrud & Perkkins, 2015). Figure 1 visualizes the linear and circular supply chain.

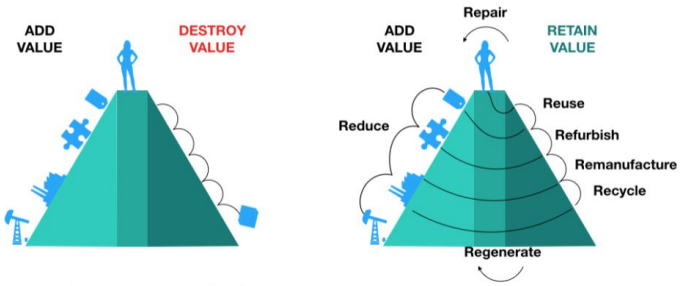

Figure 5: Visualization of linear and circular supply chain.
Source: (Achterberg, et al., 2016)

The descriptive meaning of CE is related to the theory of the cycle, which contains two cycles, biogeochemical cycles and the idea of products recycling (Murray, et al., 2017). CE concept is basically balancing the development of economy with protection of environment and resource (UNEP, 2006). Further, Ellen MacArthur Foundation (2017) defined "A CE aims to redefine growth, focusing on positive society-wide benefits, it gradually decoupling economic activity from the consumption of finite resources, and designing waste out of the system (Rattalino, 2017). Likewise, there are a number of definitions and multiple principles of CE exist in the literature (Prieto-Sandoval, et al., 2017; Pompon & Moncaster, 2016). The following four components are recognised as essential to establish the CE concept through a research analysing more number of CE definitions which are 1) the recirculation of resources and energy, the minimisation of resources demand, and the recovery of value from waste, 2) a multi-level approach, 3) its importance as a path to achieve sustainable development, and 4) its close relationship with the way society innovates (Prieto-Sandoval, et al., 2017).

Moreover, a conceptualised definition for CE was derived from Kirchherr, et al. (2017) who have defined CE, after analysing 114 definitions, as an economic system that replaced the 'end-of-life' model through reduction, alternative reuse, recycling and recovering materials in production, distribution and consumption processes. Moreover, authors stated that the aim of the CE concept is to achieve sustainable development which simultaneously generates viable natural environmental, economic prosperity and nurturing community (Wu, 2005; Shen, 2007). Further, it is an industrial system concentrated on closing the loop for material and energy flows and contributing to long lasting sustainability (Genovesea, et al., 2017). Additionally, CE integrates strategies and policies for optimise energy efficient, materials, and water consumption, whereas waste discharging to the environment is minimal (Geng, et al., 2013). Furthermore, the closed loop economy and design to redesign thinking are the two concepts that are the causes for the uniqueness of CE and also it contains low energy consumption, less pollutants emission and high efficiency (Murray, et al., 2017). To conclude, CE highlights the repair, reuse, refurbishment, remanufacturing, cascading and upgrading of materials, products and components, in addition renewable and waste-derived energy consumption all through the value chain of the product and cradle-to-cradle life cycle (Mihelcic, et al., 2003; Braungart, et al., 2007).

3.2 NEED FOR CIRCULAR ECONOMY IN APPAREL INDUSTRY

The apparel industry is having a resource-intensive supply chain which pollutes water, soil and air; as a result it is one of the notable polluting industries in the world (Leonas, 2017). Considerable amount of CO_2 is emitted during the production of petrochemicals, from which more than 60% of textile fibres are derived and balance are ruled by cotton which lead to toxic pollution, by rigorous pesticides usages (Sandin & Peters, 2018). Most elements of apparel supply chain have negative impacts on the environment as samples dyeing, finishing, printing are emitting toxic substances, and spinning weaving, knitting are relying on fossil energy (Roos, et al., 2015). In addition, greenhouse gas emissions, usage of water, discharge of toxic substances and huge waste generation are the leading environmental issues for the apparel industry (Allwood, et al., 2006). Thus, to overcome the

aforementioned challenges, the need for CE concept is raised. The implementation of CE could reduce the virgin fibre production and which lead to avoid engineering processes further downstream in the textile product life cycle, and thus reduce environmental impact as well (European Commission (EC), 2008).

Conventional approaches to solve the matters relating to waste, sustainability, and resource depletion have not addressed a complete image to attain sustainability (Martin, 2013). Moreover, to support communities in achieving a sustainable growth, the need for a CE has been widely acknowledged (Ghisellini, et al., 2016). Thus, CE has the potential to solve the gap resulting from natural resource scarcity and global growing population or consumption, especially when the relationship between resource use and waste residuals is considered (Andersen, 2007). Other than the environmental factors, CE can act as a potential answer for economic loss of the apparel industry and it provides economic efficiency to the organisations (Geissdoerfer et al. 2017; Haas et al. 2015; Park et al. 2010) which covers a technique of economic value making. Figure 2 shows an example about how CE effecting on material demand, it would reduce the amount of material consumed to a lower set point.

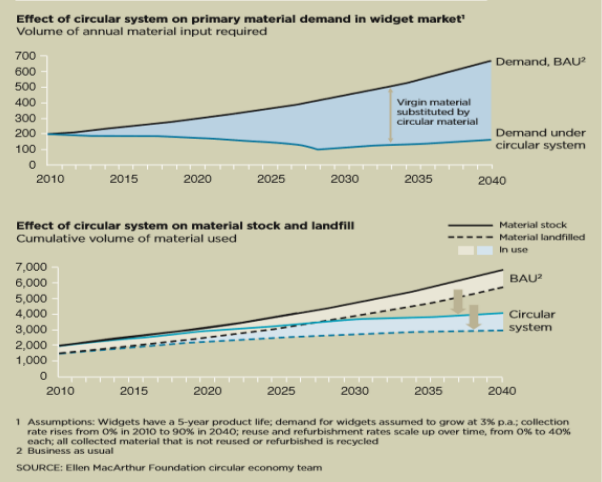

Figure 6: Effects of CE on material demand

The above graph clearly highlights the generous savings result through circular arrangement by showing the variances among the businesses as usual (BAU) and the circular scenarios of both fresh virgin materials required and the build-up of stock.

3.3 APPLICATION OF CIRCULAR ECONOMY IN APPAREL INDUSTRY

Several countries have adopted the CE model to attain environmental and economic sustainability; some of those are China (Korhonen, et al., 2018) Europe (Gregson, et al., 2015), Bangladesh (Moktadir, et al., 2017), Australia (Giurco, et al., 2014), Dutch (Fischer & Pascucci, 2017), Denmark (Tajuddin , 2019), Brazil (Amaral, et al., 2018) and Romania (Staicu & Pop, 2018). CE is applicable for all the industries and among those it is widely used in apparel industry. Certain leading apparel manufacturing organisations in the multinationals viewpoint such as H&M, Inditex and Bestseller have adopted CE models already for the environmental and economic benefits. Likewise, PUMA has established a new track for shoes and clothing named as INCYCLE™, which consists in biodegradable or recyclable products where all certified Cradle-to-Cradle™ (Ellen MacArthur Foundation, 2013). The Figure 3 summarises some of the classification of textile reuse and recycling route. Textile recycling is mostly discussing as the reprocessing of pre or post-consumer waste of textiles which is used either in new textile or non-textile products. Generally, it is classified as mechanical, chemical and thermal; however, it is unclear and debatable. Thus, this summarization was based on the disassembly level of the recovered material.

Fabric recycling used when the fabric is recovered and reused in new products, Fibre recycling is used when the fabric is dissembled, but preserved with original fibres, Polymer/Oligomer recycling is referring as the fibres are dissembled, but preserved with the polymers/oligomers and Monomer recycling is referred as the polymers/oligomers are dissembled, but preserved with the monomers. Additionally, closed loop and open loop recycling were considered here. Closed-loop and open-loop recycling are referring to when the material of a product is recycled and used in an identical product, in another product respectively. Whereas Figure 4 provides an overview of the fibre content of the materials being reused or recycled, and the type of recycling routes is employed. Here, numbers correspond to the number of cases examining reuse, or a specific recycling route, for a certain material.

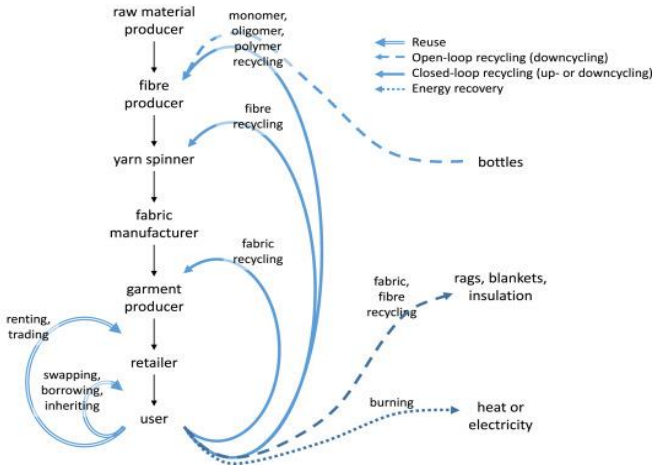

Figure 7: A classification of various forms of reuse and recycling.
Source: (Sandin & Peters, 2018)

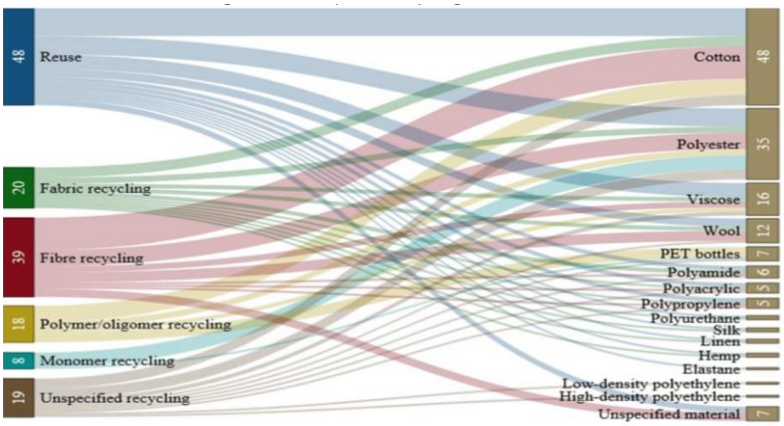

Figure 8: An overview of the fibres content of the materials being reused or recycled, and the type of recycling routes being employed
Source: (Sandin & Peters, 2018)

Above figure 4 was developed based on a literature analysis on environmental assessments of textile reuse and recycling using 41 publications. 57%, 37%, 23% and 14% are the percentages of studies carried out on fibre recycling, polymer/oligomer recycling, monomer recycling and fabric recycling. The high prevalence of fibre recycling is probably due to the fact that it is a relatively common recycling route, widely applied in commercial scale both in terms of open loop and textile-to-textile recycling.

3.4 BENEFITS AND CHALLENGES OF ADOPTING CIRCULAR ECONOMY

3.4.1 Benefits of adopting Circular Economy

The adoption of CE provides multiple benefits that are listed in Table 1.

Table 13: Benefits come through adoption of Circular Economy

Code	Benefits	Sources						Count
		1	2	3	4	5	6	
B1	Environmental gain	*	*	*	*		*	5
B2	Economic benefit	*	*	*	*			4
B3	Resource optimisation		*	*	*		*	4
B4	Collaboration among stakeholders	*	*					2
B5	Extended producer responsibilities					*		1
B6	Eco friendly labeling					*		1
B7	Respond quickly to market demand						*	1
B8	Promote industrial upgrading						*	1
B9	Improve the energy efficiency						*	1
B10	Sustainability			*				1
B11	Connectivity of material streams – cluster collaborations		*					1
B12	Design for end-of-life		*					1
B13	Enhance job growth				*			1
[1- (Jia, et al., 2020), 2 - (Boiten, et al., 2020), 3-(Gardettia, 2019), 4-(Snoek , 2017), 5-(Lofgren & Enocson, 2014), 6- (Du, et al., 2010)**]**								

Environmental gain has been identified as the significant benefit come through adopting CE which means mainly the reduction of environmental pollution. Then, economic benefit and resource optimisation have been mentioned in four sources. The cost savings presented by more widespread recovery and reuse. Also, the Resource optimisation comprised of resource productivity, optimise research usage, allow the necessary time and space for natural resource regeneration and avoid natural resource depletion. Moreover, Collaboration among stakeholders includes both collaboration among organisational and environmental collaboration with customer and suppliers. In addition, *Eco friendly labelling*, The European commission (2012) introduced eco labelling. This is a label, which gives promise to the consumer that the product is sustainable and produces little waste. This labelling is not yet common for textiles but is seen as an opportunity for the future to gain legitimacy.

3.4.2 Challenges to adopt circular economy

Adoption of the CE at the organisational level is a challenging job given the linear economy mind-set dominant in most organisations (Ellen MacArthur Foundation, 2013). The speed and scale of the circular transition will depend on knowledge, awareness and engagement of all market participants (Koszewska, 2018). Table 2 presents the challenges of adopting CE.

Table 14: Challenges faced during the adopting circular economy.

Code	Challenges	Sources								Count
		1	2	3	4	5	6	7	8	
C1	Expensive	*	*	*	*		*	*		6
C2	Advanced Technology	*	*		*	*	*		*	6
C3	Measuring the (financial) benefits	*				*	*			4
C4	Lack of knowledge and awareness	*		*				*		3
C5	Lack of support, commitment and leadership	*			*				*	3
C6	Lack of systematic regulation	*	*				*			3
C7	Lack of social and cultural acceptance		*		*		*			3
C8	Lack of risk taking attitude	*				*				2
C9	Integration between functions					*				1
C10	Missing exchange of information					*				1
C11	Value chain structures					*				1

C12	Low quality materials				*					1
C13	Lack of infrastructure						*			1
C14	Time consuming						*			1
C15	Complexity				*					1
C16	Thermodynamic				*					1
[1- (Jia, et al., 2020), 2-(Boiten, et al., 2020),3-(Gardettia, 2019), 4-(Korhonen, et al., 2018), 5- (Ritzena & Sandstroma, 2017), 6- (Snoek , 2017), 7- (Lofgren & Enocson, 2014), 8- (Geng & Doberstein, 2008)**]**										

Expensive and *Advanced technology* have been identified as the most noteworthy challenges when adopting CE. The code expensive, Swedish apparel industry as an example, Plam (2011) mentioned that, "there are clear economic barriers in the Swedish apparel market, which hinder the implementation of a CE. That makes it relatively cheaper to produce new garments than recycled or reused old ones, which in turn makes the price of second hand garments not competitive enough compared to new ones". In case of advanced technology, there is a need for major changes in both the products and the production/take-back systems and they were hesitant about how that would work and what it would cost. Additionally, about the quality issue as well (Geng & Doberstein, 2008). Further, the still largely inadequate technological capability to provide high value recycling of textile fibres was a recurring concern by stakeholders across the case study locations. Next to that, *Measuring the (financial) benefits has been cited in four sources*. There is an uncertainty about how revenues would be generated through CE adoption and about what values an increased sustainability of their deliverables would give. These changes also take time, investments and the logic in the financial system are focused on rapid returns on investments and cost saving, making it difficult to convince owners of a long-term system change.

Even though, only two out of eight have been mentioned the *Lack of risk taking attitude*, it is one of the most prominent barrier, Ritzen and Sandstrom, (2017) stated that "it was the overall large risk aversion and the business logic of taking small safe steps in the development of the organization". *Lack of knowledge and awareness, there is unfamiliarity* with the CE concept and having a shallow understanding of its meaning, which prohibits an evolutionary change towards CE. *Lack of systematic regulation* is definitely a challenge to have a dramatic change like introduction of CE into organisations. Likewise, The European commission (2012) mentioned that tax incentives, increase tax either on specific waste streams and extended producer responsibility, tax in relation to the final amount of waste that is thrown away must be included into regulation as sustainable opportunities in future. If the producer has to pay for how much that is thrown away in the end, it would make them produce more sustainable and recycled products. Moreover, *Integration between function* is mentioned by only one source, but that is a key challenge to establish CE into organisations as CE is far too complex to be handled by a single department, still it is unclear how the responsibility for CE would be managed within the organisation.

4. Conclusions and way forward

The study evaluated the CE concept and its importance in the apparel industry. CE was well established in China, Bangladesh, Europe, Australia and Germany, though it is a novel concept in Sri Lanka. Based on the literature findings, it has been evident that CE concept has been incorporated successfully within the apparel industry across several countries, providing environmental and economic benefits. However, the paper also presented the key benefits and challenges of adopting CE concept. The main benefits are environmental gain, economic benefit, resource optimisation and collaboration among stakeholders and the main challenges are expensive, advanced technology, measuring the benefits especially financially, lack of support, knowledge, awareness, commitment and leadership, systematic regulation, social and cultural acceptance. Moreover, this paper lays the platform to carry out the research to analyse the applicability of CE in Sri Lankan apparel industry, which is the way forward of this study.

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SOCIAL MEASURES OF RESILIENCE
An investigation into community resilience by taking adaptive physical measures through social mediation during infrastructure disruption

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Abstract
This paper intends to break down a local case to grasp the possibility of adaptable measures by individuals and systems through the social exchange during infrastructure interruption on account of considerable precipitation. Finally, the extent of social resilience is assessed through the '5S' framework. The assessment reveals the social capital and the incredible social conditions accomplished by the mix of the particular circumstance and differing interest packs are influencing the adaptable appraisals which can be considered as an important report to structure a strong framework by understanding the tangled social issues and multifaceted nature

Keywords: *Resilience, Hatirjheel, Social-capital, Adaptive-measures*

1. Introduction

Water clogging is a common problem in Dhaka city during the rainy season. But the causes and consequences vary in different parts of the city. To solve this problem, diminishing Hatirjheel has been revived. Yet, the incongruity is, the location of the site under infrastructure disruption is just beside of Hatirjheel. The site BIAM area is named after BIAM Foundation which works as a landmark for the area. Though this is a very small urban area, land-use is diversified and the community is heterogeneous. So, infrastructural disruption has a multifaceted impact. This paper aims at investigating the extent of social resilience in the BIAM area. It has documented the social contexts, social mediations, and adaptive measures under the '5S' framework to assess the level of social resilience. This assessment can be important for the community to better understand their problems, raise awareness among them, and to prioritize community goals. Thus, it will eventually result in better resilience-related activities

2. Methodology

This paper has four facets. In the first stage, to gather knowledge about social resiliency and to find out a framework for assessing social resilience, a meticulous literature review has been taken place. From the literature review, the '5S' framework for social resilience is taken to evaluate the extents of social resilience in the intended area.

In the second stage, the development of the site over time is studied. To do so, both the literature review and site surveying are carried out. Then, the next task is to scrutinize that includes investigating the causes and consequences of the drainage infrastructure disruption during rain, mapping the extent of the problem, damages, and adaptive measures taken to cope up. This investigation has been carried out through extensive site surveys and interviewing local people.

The third stage is interviewing local people for understanding the tangled social issues. 40 people took part in the interview and the household profile of them is as the following chart.

The fourth stage is to present the collected information under the '5S' framework of social resilience. This framework has formulated the study in a structured manner and so, all the social issues are discussed under this framework.

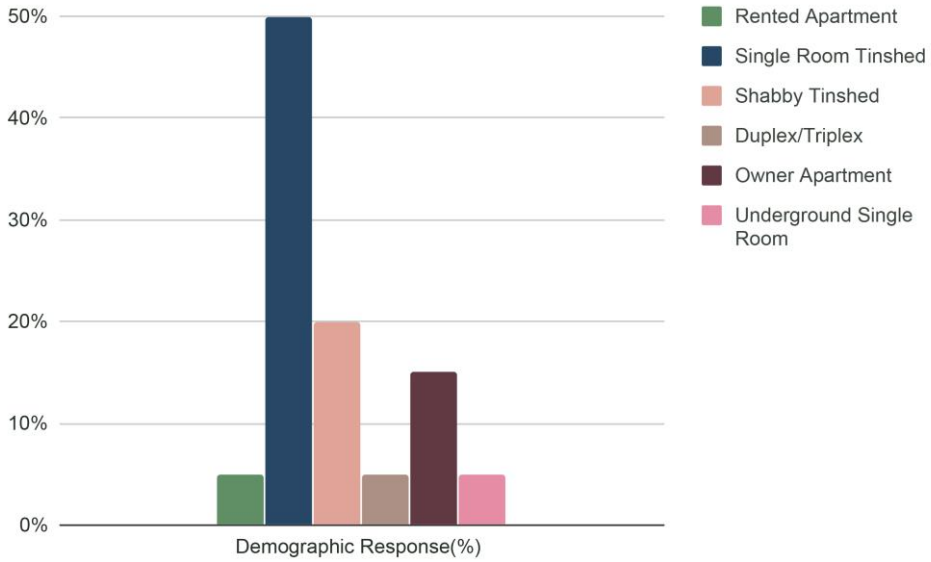

Figure 1, The household profiles of the respondents. *(Source: Field survey mapping: Design Studio Report, BUET)*

3. Literature Review

To scrutinize the degree of social resilience in an area, it is required to illuminate the term 'social resilience' and the "5S' framework of resilience '

Social resilience can be defined as a collective capacity of a neighborhood or topographically characterized zone to deal with shocks and proficiently continue the rhythms of lifestyle through participation taking aftershocks (Aldrich, 2012). From this definition, it can be said that social resilience is characterized by collective action or mediation to withstand in any shock. Then the question arises, how a community can work together when there are contrasting interest groups? To answer this question, it is required to address that there will have inequality between different interest groups. It is often argued by scholars in disaster recovery that risk and access to recovery programs are not equal among all social groups (Wisner, 2004). This is a clue to argue that the uneven extent of social resilience is an obvious result in society to society. Therefore, a framework is needed to understand the resisting capacity of society. There are many approaches to measure social resiliency. This paper is following the '5s' framework (Saja, et al., 2018) which is reflected here :

Social structure:
It indicates the demographic composition of society. It reflects society's heterogeneity or homogeneity from economic, social standing, ethnicity, or other points of view.

Social capital:
(Hanifan, 1916) recognized social capital as friendliness, fellowship, mutual empathy, and social intercourse amongst a collection of individuals and households who make up a social unit

Social mechanisms:
The mechanism by which social mediation engages community people to take part in the resilience-building process towards surviving and adapting to disasters.

Social equity and diversity:
It marks the equality in terms of access to a various set of resources, and services which tends to ensure equity for people with specific needs to manage catastrophes.

Social beliefs:
It denotes the cultural practices, social behaviors, faith-based values, etc can also have an impact on the extent of social resilience

This paper investigated the flood-affected area meticulously and the social conditions are expressed under the above-mentioned framework by (Saja, et al., 2018) to assess the social resiliency of the community.

4. Site development in time with their respective land use, infrastructure and building types

Hatirjheel, according to 'Kingbodontir Dhaka' a book by Nazir Hossain depicts that in the nineteenth century the British government and the local Zamindars used Hatirjheel for elephant bathing. Hatirjheel was a low-lying area with just about a withering water channel up to the Begunbari trench because of infringement by several controversial Highrise structures and, numerous slums. In 1997, RAJUK (Rajdhani Unnayan Kartripakkha or Capital Development Authority) had taken initiative to develop Hatirjheel as a commercial area with a lake. As a commercial area and environment-friendly activities cannot go hand in hand, there were protests from several quarters to prevent it. RAJUK had also planned to construct a multistoried commercial building on 13 acres of Hatirjheel-land, all these were contrary to the preservation of Hatirjheel. This lake can hold around 3.06 billion liters of water, and during the rainy season about 4.81 billion liters of water, making it the biggest waterway inside the capital of Bangladesh. (BBS[1], 2011)

On the eastern bank of Hatirjheel and overlooking the Sonargaon Hotel, the residential area of Biam road and the Dilu road was established after the Pakistan period. (BBS, 2011)

This interesting site, as a contextual setting, was chosen for the intended research because of the diversity of the social class in the same context and to understand their coping mechanism to each problem that appears in a multiscalar approach and how their lives get affected by the Hatirjheel water basin is the intended disclosure.

Figure 2, Hatirjheel and the Catchment area's contextual land use demography (*Source: GIS)*

From figure 2, it can be seen that the area comprised of mostly residential buildings. The BIAM school and Jhil mosque with madrasah are two important landmarks in this area.

5. Diagnostic Scrutiny: Causes and consequences of the drainage infrastructure disruption during rain

5.1 CAUSES AND CONSEQUENCES:

[1] BBS: Bangladesh Bureau of Statistics

The infrastructure disruption of the BIAM area is a result of undertaking segregated development projects of the Hatirjheel which ignored the necessity of integrating its services with the existing infrastructure of the surrounding area. Before the construction of the Hatirjheel bypass road, the road on the east side of the lake was quite lower than the present road level. So, the bypass road worked as a barrier for surface stormwater runoff and eventually caused water clogging in the rainy season. After the construction of the bypass road, the peripheral road level was raised 3' than the existing level, and the sewerage line and stormwater drain were installed above the existing line. As a result, the pre-existing infrastructure of the sewerage system failed to meet the new infrastructure system of Hatirjheel. The preceding system then runs towards Dilu road and finally crosses at the BGMEA (see figure 2) intersection to meet the gradient. The rainwater drainage pipe previously ran parallelly and met the BGMEA crossing which also failed to meet the proper gradient, substantially was another cause of water clogging of this area.

The accessibility of the BIAM road (see figure 2) is reduced as people need to take rickshaw with a high rent as much as 20 takas to cross the water clogged portion of the road which is hardly 100m. Slum-dwellers face problems in terms of preparing food, damaged furniture, clogged toilets, odor, and health issues. The disruption of infrastructure also affects social infrastructures here. BIAM school remains closed during rainfall for more than 4 hours due to water clogging. The jheel mosque also faces an accessibility problem. Besides, the ablution space is also clogged which makes severe inconvenience to the Musulli.

5.2 MAPPING THE EXTENT OF THE PROBLEM

To map the extent of the problem the BIAM area was visited and the problems were documented. Relation among duration of rain, water level, and duration of water stagnancy is mapped. From that data, it can be seen that if rainfall takes place for more than six hours the height of the water reaches as much as 4 feet and the water becomes stagnant as long as 48 hours. When the duration of rainfall lies between 1-2 hours, the height of water fluctuates between 2 to 3 feet and remain stagnant for 2 to 5 hours. And if the time of rainfall increased to 3 hours water level fluctuates between 3 to 4 feet and longevity gets a two-digit figure like 10 to 14 hours.

Figure 3, Water clogged BIAM road. left: disrupted pedestrian and vehicular movement. Right: Disrupted economic activity. *(Source: Author)*

On the other hand, the local nature of the flood in terms of the degree of disruption within the range of high to low is mapped. It can be seen that the slum area, the BIAM school(see fig 2), and the building opposite to BIAM school are mostly affected.

The slum area becomes severely affected with 1 to 3 feet high water level that seems to stop their regular life with the scarcity of drinking water and food.

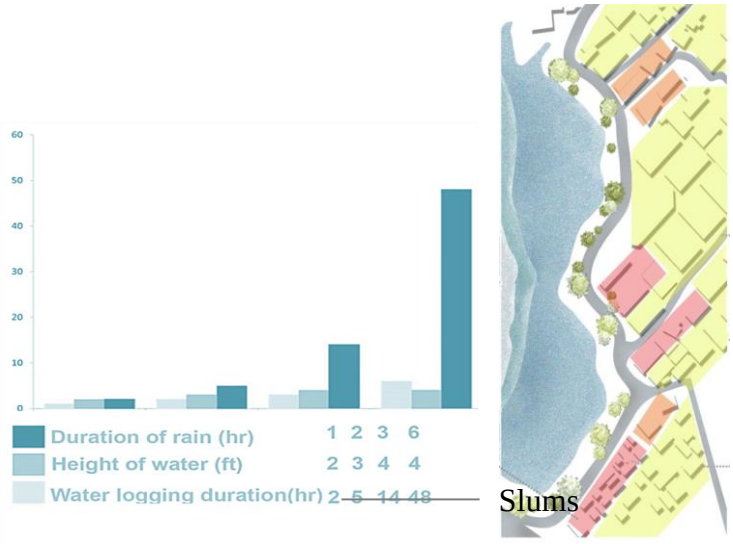

Figure 4, (left): relation among duration of rain, the height of the water, and water clogging duration. (*Source: Field survey. Graph: Design Studio Report, BUET)*. (right): The Map of the affected area. Red: Most affected, Orange: Medium affected, and Yellow: Less affected area *(Source: Field survey mapping: Design Studio Report, BUET)*

6. '5S' Framework of social resilience

6.1 SOCIAL STRUCTURE:

In terms of occupants' characteristics, this area houses diverse professionals including secretaries, politicians, service holders, shopkeepers, day-laborers, street vendors, etc. Most of the residents are job holders in various government and private organizations and banks. The slum residents work nearby in the shops and some as street vendors of various items. For their livelihood, the women work as house-help and work from house to house.

As for the children, they tend to go to the nearby madrasah for education as well as work as shop-helps in local tea-stalls or assist the street vendors.

A majority of the residents, the women, and the elder people tend to walk around the lake in the evenings, and children play on the street overlooking the lake. The younger people tend to gather around the tea stalls to talk and socialize. They try to maintain a mosque-based community and try to voice their demands through a guardian body elected as the mosque committee. In recent years, a new neighborhood welfare foundation has started its journey with the help of Mrs. Rouf, naming the "Abdur Rouf Foundation" in commemoration of founder-curator of Bangladesh Film Archives late A.K.M AbdurRauf (1935-2000).

Figure 5, Two spectra of demography; Left side: Slum dwellers on the vicinity of Hatirjheel context, Right side: Middle-class people's dwelling places. *(Source: Author (left), Design Studio Report, BUET (right))*

6.2 SOCIAL MECHANISM:

The mosque plays a vital role in this community. This is the only place where people from all social groups can congregate. Sometimes, the mosque committee works to various voice raising issues for the community. Through this voice raising process, some developments also accomplished. For example, a secondary water chamber was established near the jheel mosque so that it can immediately absorb the rainwater, and then it would meet the main rainwater drainage line which ran towards Dilu road.

Therefore, the social mechanism works better in taking adaptive measures to solve the accessibility problem of the mosque during the flood. To provide accessibility to the mosque, temporary sandbags are laid on the ground so that people can use it to approach the mosque. Community people also collected money and constructed a stepped flood barrier to protect the mosque from being flooded.

On the other hand, BIAM school is an institutional building, and the students of this school face accessibility problems during a heavy downpour. Biam School authority usually gives early holiday and as the campus is 5' lower than the constructed road, a passageway made by using benches is provided temporarily for students, teachers, and staff to use

Figure 6, Community people using different adaptive measures for Biam school and the mosque. (*Source: Author)*

During rainfall, residents try to unclog the surface drains which gets clogged because of littering waste.

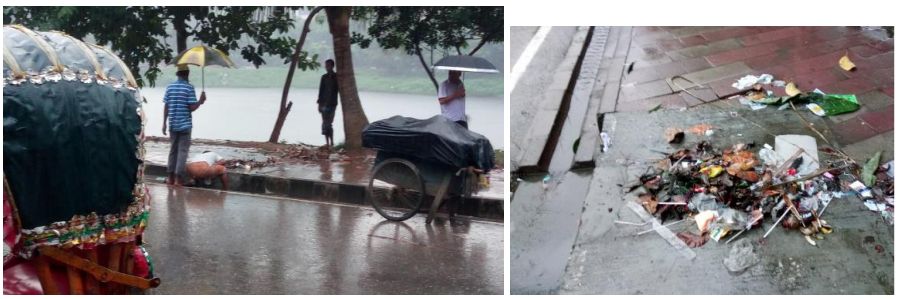

Figure 7, Community people unclogging the surface drain for better passage of stagnant water. (*Source: Author)*

6.3 SOCIAL CAPITAL:

This is known by now, social capital refers to the social connection between individuals. So, this is a very difficult thing to determine the extent as it is a subjective measure. Instead of any questionnaire survey, this paper depends on the empirical evidence that reflects the state of the affairs among the members of the society. The followings are some empirical evidence that can be considered as a determinant of the social capital of the community.

6.3.1 Road development :

The proposal for raising the road level is weakened by the disapproval of a significant amount of community people. Here is a demonstration of responses from different interest groups which shows that about 40% of the respondents are negative about raising the road elevation as their houses will go under road level if the road is elevated. It indicates the direct conflict in the community and their inclination towards individual benefit is expressed

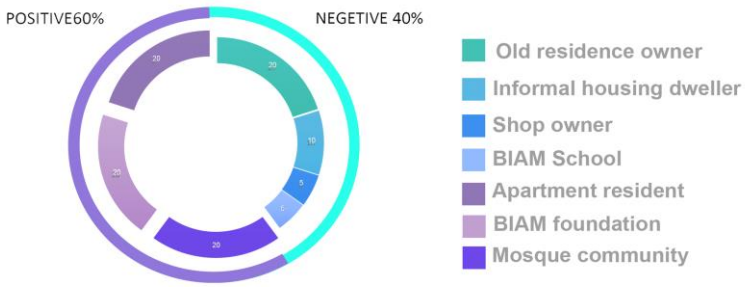

Figure 8: Positive and Negative response regarding road elevation and the breakdown of the participant's profile (*Source: Design Studio Report, BUET)*

6.3.2 individual efforts to adaptation:

This is evident from the field survey that people are more tending to depend on individual adaptation mechanisms, as the community is unable to take unified action due to conflicts among different interest groups. This individual adaptation mechanism is comprised of several actions such as using a water pump to drain out water from personal premises, constructing a flood wall, elevating the plinth level, etc. All of them are subject to a high amount of cost and so only accessible to upper or upper-middle-class people. But the slum dwellers do not have the luxury to adopt any mechanical means or elevating the plinth level of their houses. On the other hand, pumping out water from the personal premise and obstructing the water by flood wall increase the amount of stagnant water in the BIAM road, which eventually worsen the situation for common people. So, there is no cohesion in social groups in individual-level adaptation. Instead of improving the situation, it is making the problem more severe for common people.

Figure 9, Pumping out water to BIAM road from personal premises (left), flood wall (right)(*Source: Author)*

6.3.3 scarcity of food and drinking water in the slum area :

From the field survey, it has been seen that many slum dwellers face acute scarcity of drinking water and food during the flood as their cooking place goes underwater. They can't cook food to eat and can't boil water to drink. Some of the slum dwellers have elevated their cooking places to adapt to the flood.

Though the problem of food and water is acute, no community involvement is evident to support their helpless neighbors. Respondents from the slum area have expressed their miseries and helplessness during the interview. This is evidence of a loose connection between the slum dwellers and the other part of the community.

Figure 10, Water clogged slum area causing scarcity of drinking water and food.(left), elevated gas burner for adaptation(*Source: Design Studio Report, BUET)*

From the above mentioned conspicuous shreds of evidence, it can be concluded that social capital is very weak and can't play a significant role to tie the community to withstand the shock as a whole.

6.4 SOCIAL EQUITY AND DIVERSITY:

There is no equal access to resources and services for the entire community. The slum dwellers face problems regarding electricity, drinking water, food, etc. and these problems become more acute during any infrastructural disruption. There is no evidence of sharing resources to ensure equity in the community level. So, it can be concluded that this community lacks equity in terms of access to resources or services.

6.5 SOCIAL BELIEFS:

The community people have strongly believed in the power of residents who are bureaucrats or politicians to come forward to solve the problems. Though the community people have no or little interaction with that elite group, they trusted the power of the social elites. But the development of the Hatirjheel bypass road was conducted by another authority (Bangladesh Army) and so no political or bureaucratic influence could have changed the situation. This social belief had the promise to unify the community under strong leadership. But, it didn't take place due to the heterogeneity of the community profile and the weakness of the social capital. This reasoning is stated based on the interviews of the local people

7. Discussion

From the '5s' framework it can be deduced that the society under consideration is heterogeneous in demographic profile and the social capital is also very loosely tied. Social equity isn't evident and the social beliefs can't contribute due to loose social connections. The only social entity that plays a role in mediating tangled issues is the mosque where people from all the interest groups congregate regularly. From this observation, it can be claimed that the social interaction at the mosque has created the opportunity. And to strengthen the social capital this mosque can house other sorts of communal activities or other social organisms that provide the opportunity to mix different social groups, can be launched.

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SUFFICIENCY OF THE POLICIES RELATED TO CONSTRUCTION INDUSTRY IN SRI LANKA

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Abstract
Public policy on construction will reflect the economic, political, social, and cultural status of Sri Lanka. The construction industry in Sri Lanka has faced many issues in the recent past because of unsuccessful government policies. Therefore, an effective national policy for the construction industry has become necessary. Thus, the aim of this study was to examine the effectiveness of the existing construction policies. The empirical data required were collected by interviewing ten experts, who were selected using snowball sampling. The collected data were manually analysed using content analysis. The findings revealed that the National Policy on Construction (NPC), formulated by the National Advisory Council on Construction, which was set up under the Construction Industry Development Act No. 33 of 2014, is the only construction policy that has been formulated in Sri Lanka so far. NPC contains eighteen (18) policies applied for both the public and private sectors. Although according to the literature, policies in Sri Lanka change along with the change of governments, the study revealed that NPC, which has remained unchanged since its formulation in 2014, is still applicable in the country.

Keywords: *Construction Industry; National Policy on Construction (NPC); Sufficiency Level.*

1. Introduction

The construction industry in any country plays a significant role in economic development by contributing to the Gross Domestic Product (GDP) and creating employment opportunities (Dixit *et al.*, 2017). The industry is the main beneficiary of the increasing number of infrastructure projects that are being implemented to support rapid urban development in Sri Lanka, and is the fourth-largest industry in the country today, with its percentage contribution to the GDP during the past 10 years amounting to 6-7% (Jayalath and Gunawardhana, 2017). Besides, the government's construction policy represents the country's economic, political, social, and cultural status (Seaden and Manseau, 2001).

According to Khan (2016), a policy is typically a general statement on objectives, written laws or regulations, processes, and standards. In its simplest sense, policy refers to a definite course of action apposite for the achievement of one or more anticipated goals at intervals in a chosen context and at the preference of a company or individual (Mackay and Shaxton, 2005). The success of such a policy will, however, depend on the effective implementation of the policy (Rajapakshe, 2017). According to Meier, Ripley, and Franklin (2016), even the best policy will not be of any value if it is not applied effectively or correctly.

Stable government policy on construction will be very useful to overcome the numerous issues currently faced by the construction industry in Sri Lanka (Silva et al., 2008). Ratnasingham (2015) stated that a major concern of the industry is the changes made to construction policies as governments change. Past studies have discovered that these changes directly affect construction development (Finco, 2017). Loopholes that exist in the current construction policy can lead successive governments to change it to suit their agendas (Silva et al., 2008). An unstable construction policy will prevent the construction industry in Sri Lanka from being competitive with the construction industries of other developing countries (Ratnasingham, 2015). However, no detailed study has so far been conducted to reveal the shortcomings of the current policies on construction in Sri Lanka. Moreover, it is quite important to identify the current implementation level of the construction policies in Sri Lanka. Thus, the aim of this study was to examine the sufficiency of the existing policies on construction to ensure the competitiveness of the construction industry in Sri Lanka.

2. Literature Review

2.1. CONSTRUCTION INDUSTRY

The construction industry is a significant component of the national economy of a country since the industry is involved with the construction, reconstruction, maintenance, and demolition of buildings

in the country while contributing to the country's economic development (Timofeeva, Ulrikh and Tsvetkun, 2017). In Sri Lanka too, the construction industry is one of the significant contributors to the economy, while being a creator of employment (Ministry of Housing Construction & Culture Affairs, 2019).

GDP is an indicator of the growth of the economy of a country (Vijayaragunathan and Rasanthi, 2019). GDP is affected by periodic and unconditional recessions and booms in the national economy (Abdalla, 2016). The construction sector, which has an impact on GDP, is responsible for the industrialization of a country (Alaghbari, Al-Sakkaf and Sultan, 2019). The GDPs of developing countries have a tendency to decrease with oil price increases, power scarcities, and political uncertainties (Kira, 2013). According to the National Advisory Council on Construction [NACC] (2016) in Sri Lanka, the construction sector in the country performs a significant role in the economy of the country by creating employment opportunities for the industrial sector. Besides, the industry has a positive impact on the national economy because it stimulates economic development (Hosein and Lewis, 2015). By giving little consideration to the construction industry (Oladinrin, Ogunsemi and Aje, 2012), policymakers have failed to get the industry to drive the country towards economic development. Today, the construction industry in Sri Lanka is one of the most neglected industries in the country.

2.2. GOVERNMENT POLICY

A government of a country is a collection of public sector agents committed to effectively and successfully guide the units or communities in the country (Link and Scott, 2010). One of the main responsibilities of a government is to develop and manage the policy framework of the country. Moreover, government policy is a principle or a course of action that a governing body proposes or implements (Meier, Ripley and Franklin, 2016). The policies and regulations formulated by a government can either encourage or hinder the development of new strategies and innovations. Further, in any sector, significant and fundamental changes can be made through strict and focused policies and regulations (Patanakul and Pinto, 2014). The government can also make policy adjustments based on economic conditions prevailing in the country. Therefore, if a change in government policies becomes really necessary, the government has to avoid politically negative behaviour (Janssen and van der Voort, 2016).

According to Young (2013), by setting the foundation for all the people to operate through public policymaking, governments have the option to decide on the social goals they should pursue and the way those goals should be attained. According to Anderson (2010), public policy is also a collection of actions indicating the extensive framework required for a philosophy, concept, vision, or decision to be put into operation and transformed into numerous programs, projects, and actions. Though there are different definitions for public policy, the success of the public policy is indicated by how successful its implementation is. Unless a public policy is successfully implemented, it will not be possible to achieve the objectives of the policy (Meier, Ripley and Franklin, 2016).

2.3. Parties involved in the public policy cycle

The key players involved in policymaking get the opportunity to interact with one another at different stages of the policy cycle. Individuals, agencies, and institutions that interact with the policy process are called actors (Moran, Rein and Goodin, 2008). Governments are generally the only bodies interested in policymaking and have the authority to take policy decisions and prepare budgets, while the actors contribute to public policy, typically through the networks responsible for fulfilling the policy objectives of the government (Foxell and Cooper, 2015). According to Mackay and Shaxton (2005) the functions of the various stakeholders involved in the public policymaking process are as follows:

- Government: To serve as a public behaviour operator
- Public sector workers: To provide technical expertise and policy advice
- Political Parties: To develop linkages in exchange for political support

- Media: To generate interest among the public by reporting information and shaping public opinion
- Cabinet: To maintain a monopoly over the provision of legislation
- Interest Groups: To work towards furthering the interests of the members and to bring pressure on the political network to respond
- Legal system: To act independently and interpret the laws
- Public: To join interest groups and coalitions, form opinions, elect the government, and rely on the media for information.

2.4. GOVERNMENT CONSTRUCTION POLICIES IN GENERAL

Because of the absence of proper government policy on construction, the non-availability of sufficient funding for government projects, and the inefficient government procurement procedures, the construction industry experiences many difficulties (Hui *et al.*, 2011). The political instability of the government also has a huge impact on the construction industry since an unstable government will want to make swift changes in the public policies introduced by the previous governments (Silva, Rajakaruna and Bandara, 2008). The government has to develop clear and effective policies on construction, by defining national construction priorities and providing guidance on investment mobilisation. Further, preparation of a framework to promote the development of the local building industry through business enterprises, productivity improvements, and professional development will also be important (Khare and Agarwal, 2017).

All construction operations, such as any processes or activities necessary prior to the start and completion of the project, will be protected by the policies in the construction industry. Besides, organisations that conform according to the government's approved policy on procurement related to supplies, design plans, or perform certain construction activities may face fewer risks (Taofeeq, Adeleke and Hassan, 2019). Government policies would therefore overcome the deficiencies identified and ensure the long-term survival of the construction industry.

2.4.1. Government Policies on Construction in Sri Lanka

A major concern of the construction industry in Sri Lanka is the changes made to the policies on construction as the change of government (Wettasinghe, 2015). A former chairman of the Chamber of the Construction Industry in Sri Lanka, once mentioned that when a new government comes into power in the country, the contracts awarded during the time of the previous government are suspended and reviewed (Ratnasingham, 2015). Because of the various linkages that the construction industry has, the development of the construction industry in Sri Lanka will have a multiplier effect on national development (Ministry of Housing Construction & Culture Affairs, 2017). Therefore, a National Policy on Construction (NPC) is urgently required to be established through a holistic approach.

The NACC, established by the Construction Industry Development Act No. 33 of 2014, has been empowered to formulate a National Policy on Construction. According to the Ministry of Housing Construction & Culture Affairs (2017), the main objective of the NPC is to make the construction industry in Sri Lanka an efficient industry that can contribute to the national development through regulations, standards, capacity building, etc. The Ministry further states that the policy will identify the key roles and responsibilities of the different sectors of the industry and coordinate the policies and operating backgrounds of these different sectors to ensure complementarity. NPC will address all issues related to the matrix consisting of the various operating processes and multiple stakeholders of the construction industry because of the influence it has on the different sub-sectors of the economy (Ministry of Housing Construction & Culture Affairs, 2017). The main objectives of implementing NPC are to support human resource development, generate employment, reduce poverty, encourage social progress, ensure the availability of materials, plant, and equipment preferably through local production, and to create an environment that attracts infrastructure investment (Jayalath and Perera, 2019).

Several researchers have discussed the role of government policies and their effects (Taofeeq, Adeleke and Hassan, 2019; Taofeeq, Adeleke and Lee, 2020), and policy changes (Wong, 2019; Xiaopeng and Pheng, 2013) in the global context, while there are a few studies on the importance of government policies (Hettiarachchi, Morrison and McAlpine, 2019) and policy gaps that deter sustainable construction (Jayalath and Perera, 2019) in the Sri Lankan context. However, there is a dearth of literature on the sufficiency of the policies related to the construction industry in Sri Lanka. Since this research will further deliberate on the current implementation level of the existing national policy of construction in Sri Lanka in order to identify its sufficiency.

3. Methodology

A qualitative approach in research involves the collection of data on a problem or procedure from various parties who had encountered such a problem or followed such a procedure and the interpretation of that data by the researcher (Yilmaz, 2013; Amaratunga et al., 2002). Since the intention of this study was to examine the sufficiency of the policies related to the construction industry in Sri Lanka, the collection of in-depth opinions of experts was essential and the information obtained was evaluated descriptively. Thus, the study adopted the qualitative approach. The empirical data required was collected using ten semi-structured face-to-face interviews, each of 45-60 minute duration, conducted among knowledgeable and experienced experts associated with the construction industry. The experts were selected using the snowball sampling method, a non-probability sampling method. In snowball sampling, the study respondents are invited to help find other possible respondents and become "de facto" research assistants (Biernacki and Waldorf, 1981). When this sampling method is used, no specific sample size is required. The interviews were conducted until data saturation was reached. The data collected were manually analysed using content analysis.

4. Research Findings

Under this section, a detailed analysis was performed by collecting data through expert interviews.

4.1. WHAT IS PUBLIC POLICY?

Literature provides several definitions of public policy. At the interviews, the interviewees were also asked to define public policy. The interviewees, while confirming the literature review findings, mentioned that public policy is like the vision of a company, which can be implemented through the mission of the company. The National Construction Policy is, therefore, the vision of the Sri Lankan construction industry. The policy and its implementation mechanism should help to achieve the policy objectives of the industry. The interviewees also mentioned that any public policy should address public requirements, uphold public accountability, and contribute to the public welfare. They further stated that public policy is a statement prepared by the government to cater to the requirements of the country and that it should not contain many details. The interviewees further mentioned that the policy should be fair and reasonable to all stakeholders and that it should not contradict or violate other policies. They were also of the view that public policy is a guide to the actions that have to be taken by the public. Thus, public policy can be defined as follows:

"Public policy is the vision statement of a country, which addresses public requirements, uphold public accountability, and contribute to the public while being fair and reasonable to all the stakeholders"

4.2. SUFFICIENCY OF THE CONSTRUCTION POLICIES FOR THE EFFECTIVE OPERATION OF THE CONSTRUCTION INDUSTRY IN SRI LANKA

Under this Section, the respondents' ideas on the need of a construction policy to Sri Lanka and sufficiency of the existing policies related to the construction industry were discussed.

4.2.1. Need of a Construction Policy in Sri Lanka

The interviewees emphasised that a construction policy is required to ensure the development of the construction industry in the country. A policy is similar to the vision of a county. Thus, construction industry stakeholders can use the construction policy as a guideline when conducting their construction-related activities. According to the interviewees, for a developing country like Sri Lanka, a proper construction policy is essential if the construction industry is to be properly monitored, especially because the industry is one of the major contributors to the country's GDP. The interviewees also mentioned that a policy on construction is required to cater to the needs of the construction industry. Most of them were of the view that policies are required in an industry to ensure its consistency and stability as otherwise situations can arise which no one will be prepared to handle. According to interviewees, policies can significantly influence the development of the construction industry.

4.2.2. Sufficiency of Construction Policies

Concerning the sufficiency of the current National Policy on Construction to cater to the construction industry requirements in Sri Lanka, most of the interviewees stated that since NPC is the first such policy established for the construction industry in Sri Lanka, its effectiveness can be determined only after it has been implemented for several years. Some of the interviewees, on the other hand, mentioned that there are areas that have not been covered by NPC. For example, Building Information Modelling (BIM) for construction activities has not been covered in the policy although in other countries BIM for construction activities has been covered by their national construction policies. The interviewees were also of the view that the use of solar energy and green technology in construction should be included in any policy on construction. They also recommended that making all due payments under a contract within 90 days, should be made a legal requirement. Thus, according to the views expressed by the interviewees, the provisions made in NPC are sufficient at present for the effective operation of the construction industry in Sri Lanka. However, according to the interviewees, the proper implementation of the policy would be a challenge given the culture of the country's construction industry.

4.2.3. Current Level of Implementation of the National Policy on Construction

Table 1 lists the summary of the opinions expressed by the interviewees on the current level of implementation of NPC.

Table 1: Policy-wise implementation level of NPC

Policy	Current Level of Implementation
NPC1 – Provide strategic leadership to the stakeholders of the construction industry to stimulate sustainable growth, reforms, and improvement of the construction sector	To some extent
NPC2 – Regulate and monitor the activities of all stakeholders of the construction industry as may be prescribed from time to time	To a great extent
NPC3 – Promote sustainable economic growth of the construction industry with special attention to the design and development of disaster-resilient, energy-efficient, and environmentally sustainable buildings, structures and construction practices	To some extent
NPC4 – Promote innovation, research, dissemination, and publication of research work on matters relating to the construction industry and its development	To some extent
NPC5 – Establish national standards and specifications for the construction Industry	To a great extent
NPC6 – Establish codes of conduct, practices, procedures, processes, and documentation to promote good practices relating to the construction industry	To some extent
NPC7 – Enhance human capital, professionalism, efficiency, and productivity of the human resource of the construction industry	To some extent
NPC8 – Enhance occupational safety and health standards and practices in the Construction Industry	To some extent
NPC9 – Enhance the use of Information Technology to improve the efficiency and productivity of the construction industry processes	Not implemented as yet

Policy	Current Level of Implementation
NPC10 – Promote access to overseas markets for Construction Companies and personnel	To some extent
NPC11 – Create an enabling environment for local and foreign investment in the construction Industry	Not implemented as yet
NPC12 – Establish a monitoring and evaluation procedure to ensure compliance of industry practices including disaster-resilient construction standards & practices, with the National Construction Policy	To some extent
NPC13 – Promote domestic participation in foreign-funded construction projects implemented by foreign contractors and consultants	Not implemented as yet
NPC14 – Encourage private sector participation in policy development	Not implemented as yet
NPC15 – Encourage effective management of construction projects by the industry	Not implemented as yet
NPC16 – Establish Codes of Conduct among partners of the industry	To some extent
NPC 17 – Encourage Human Resource Development in the Construction Industry	Not implemented as yet
NPC18 – Establish appropriate procurement practices in the Construction Industry	Not implemented as yet

As can be seen from Table 1, seven of the eighteen policies have still not been implemented. Only two policies have been implemented in the industry "to a great extent" and the rest of the policies have been implemented only "to some extent". Thus, not a single policy has been fully implemented. Although NPC mentions the implementation mechanism for each policy, the interviewees indicated that most of those mechanisms are not being implemented in the industry.

Although the results of the literature have indicated that modifications made to construction policies by various governments are a major concern in Sri Lanka (Ratnasingham, 2015), respondents have reported that the only construction policy in Sri Lanka is the NPC devised by the NACC with the provisions of Construction Industry Growth Act No. 33 of 2014. Although the NPC as a whole is more than adequate for the growth of the construction industry in Sri Lanka, the relevant stakeholders have ignored the proper implementation of the policy. The true advantage of formulating this policy would not be accomplished if it were not properly implemented. This was reinforced by Hudson, Hunter and Peckham (2019) when they claimed that there is increasing consensus that a policy will not be a success or failure of its own, but that its effectiveness will depend on its implementation.

5. Conclusions and recommendations

This paper presents the policies established in Sri Lanka for the construction industry and the sufficiency of those policies for the effective operation of the construction industry in the country. A literature review was first carried out to identify in the global context the need for policies related to the construction industry. Construction policies were found to help the construction industry to develop, leading to the overall development of the country. Because of the significant contribution that the construction industry makes to the national economy, a proper national policy on construction has to be in place. A proper policy will cater to the needs of the industry and guide the industry to be effective and efficient. Policies can promote the economic activities of the country and influence the development of the construction industry. A policy should not be confined to a set of words in a document but should be implemented to ensure the development of the industry. The only policy related to the construction industry in Sri Lanka was found to be the NPC formulated in 2014 by the NACC. The policy has eighteen sub-policies and it was found that these sub-policies are still sufficient for the effective operation of the construction industry in Sri Lanka. However, the interviews revealed that many barriers are present to implement the mechanisms stipulated for the eighteen sub-policies. The real benefit of formulating this policy would not be achieved if it were not correctly utilised. Therefore, it is recommended to examine the barriers that hinder the implementation of the sub-policies of NPC and identify the strategies that can be adopted to overcome those barriers so that

the policy-makers can adapt those strategies to overcome the barriers, based on their relative importance, to achieve the goal of NPC.

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THE IMPORTANCE OF EMERGENCY PREPAREDNESS AND BUSINESS CONTINUITY PLANNING FOR BUSINESS RESILIENCE: A LITERATURE REVIEW

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Abstract
All business activities are subjected to risks such as technology failure, natural disasters, utility disruption and terrorism, etc. These risks may be potential to generate a crisis, which if left uncontrolled can become a disaster. Even a small business interruption will result in the reduction of revenues, loss in customers or reduction in market share and ultimately, the survival of a business. Therefore, Emergency Preparedness (EP) and Business Continuity Planning (BCP) play an important role in business resilience providing the capability to adequately react to operational disruptions, while protecting safety and welfare of people. Though EP and BCP form important elements of good business management and service provision, as per the literature, EP and BCP have often been overlooked and sometimes even been ignored. Therefore, this paper presents the findings of a comprehensive literature review carried out on EP and BCP concepts to fill the above research gap. The finding will help the researchers working in EP and BCP practices to understand how these concepts have been developed, how they are practiced in the industry and their importance in business survival.

Keywords: *Emergency Preparedness (EP), and Business Continuity Planning (BCP), Process, Business Resilience*

1. Introduction

Ensuring the resilience of a business in any organisation is a must for the success of the organisation in this global market. "Business resilience is the ability of an organisation's business operations to rapidly adapt and respond to internal or external dynamic changes and continue operations with limited impact to the business (IBM Corporation, 2004). All organisations need to face the risks and changes in their business environment. Risks may result in crisis, which may turn to a disaster if proper attention is not paid (Davies & Walters, 1998). Kash and Darling (1998)stated, 85% of organisations acknowledge that crises within the organisations are inevitable. Even a small business interruption will threaten the survival of a company as it result in the reduction of income, loss in customer (Davies & Walters, 1998). Risks which are very common in any organisations have a negative impact on the continuity of the business.

Maintaining a balance between business resilience and risks is very important in ensuring the success of the organisation. Risks are also created by disasters which may be either a manmade or natural disasters which subsequently result in loss of people, loss of infrastructure, loss of telecommunication to an organisation which may result in emergency situations which need to be controlled to ensure the continuity of the business operations. Emergency preparedness and business continuity planning have been widely recognised as the important tools to ensure the business resilience. Hence, this research presents findings of a comprehensive literature review on emergency preparedness and business continuity planning in ensuring the resilience of the business. The aim of this paper is to study the potential risks and emergency situations which may disturb the business continuity, the concept of EP, BCP, BCP processes and role of facilities manager in BCP. Therefore, initiated this research with literature survey and review based on books, journals, research papers, articles, previous research investigations and internet. This paper includes the in-depth analysis of the research findings derived from the literature study analysis which is used to achieve the research aim. Finally, this paper elaborates the conclusions about the research summarizing the total content of the research and further directions also suggested to carry on reaches in future.

2. Literature Review

2.1 EMERGENCY PREPAREDNESS

Emergency is an unpredicted occurrence which requires immediate action which comprises communities or individuals (Hiles, 2004). Preparedness in the context of emergency management can

be defined as a "state of readiness to respond to a disaster, or any other type of emergency situation comprising the activities, programs, that exist before an emergency that are used to support and enhance response to an emergency or disaster" (Bullock, Haddow, & Haddow, 2008). According to Newsom and Carrell (2001), "A disaster is an emergency considered severe enough by local government to warrant the response and dedication of resources beyond the normal scope of a single jurisdiction".

The definition of disasters can be classified according to its scope ranging from biological to geographical and climatologically (Warren, 2010). Apart from this industrial and transport related accidents can also be included under disasters. On the other hand when we look in to the categorization of disasters broadly, disasters can be categorised as natural disasters and man-made disasters (Davies & Walters, 1998). During recent years it is observable that many countries around the world experience an increase in natural disasters such as tsunamis, hurricanes, floods, mudslides and earthquakes (Mudalige, 2011). Manmade disasters include hazardous material spills, infrastructure failure, or bio-terrorism. According to Mudalige (2011), man-made disasters have badly influenced the economy, society and environment and have resulted in the loss of 64000 lives as well. In addition, Mudalige (2011) has highlighted that there has been 35 major disaster events with the economic loss of more than US$ 6 billion in the last 10 years.

The environment of disasters is "characterized by change, uncertainty, and a sense of urgency in which communications and decision-making systems may break down and standard operating procedures may not apply" (Lewis, 1998). Recovering from a disaster suddenly without proper preparedness is an unachievable task. According to Moore & Lakha (2006), in disaster situations humans revert to preprogramed responses rather than adapting to the situation. In order to overcome this measure such as good planning, which includes mitigation measures is very essential to avoid losses. According to the IFRC and Red Crescent Societies (2004), in the past ten years almost two billion people have been affected by disasters. Preventing a natural disaster is very difficult, measures such as good planning, which includes mitigation measures can help reduce or avoid losses. Organisations need to have a good emergency management for a better emergency preparedness. "Emergency management includes all-hazard which incorporates response, recovery, mitigation and preparedness which aims to reduce risk from civil natural, technological, biological and instrumental disruptions" (Mc Entire, 2004).

According to Wilson (2010) emergency management comprises of eight emergency management principles which highlights the inclusion of the population as an essential component to successful practices. Comprehensive and progressive are the principles which describe the inclusion of all hazards and impacts relevant to them and anticipating future disasters respectively are the first two principles of emergency management. Emergency management principles also include the risk analysis in assigning priorities and resources and it also highlights the importance of integration among all elements of a community. In addition, encouraging the trust among individuals and organisations, coordinating stakeholders towards a common purpose, innovative approach and the inclusion of person with special knowledge in the field also has been discussed in the emergency management principles (Wilson, 2010).

The aim of emergency management is to "protect communities by coordinating and integrating all activities necessary to build, sustain, and improve the capability to mitigate against, prepare for, respond to, and recover from threatened or actual natural disasters, acts of terrorism, or other man-made disasters" (Federal Emergency Management Agency, 2009). According to the American Red Cross (2008) preparedness is a cyclical process which includes actions such as risk and capabilities assessment, developing strategy and resource programme, exercising plan and schedule, training, taking corrective actions and the improvement of plans. Another way in which to view the concept of preparedness is by reviewing mitigation and preparedness which are generally considered to be

distinct activities, however at some point it is difficult to distinguish between them. Mitigation means sustained action taken to reduce or eliminate long-term risk to people and property from hazards and their effects. Mitigation distinguishes actions that have a long-term impact from those that are more closely associated with preparedness for immediate response to short-term recovery of a specific event (Federal Emergency Management Agency, 2009).

Emergency preparedness includes the collection and analysis of intelligence and information, and development of policies and plans according to relevant laws, regulations to perform assigned missions and tasks with involvement of personnel who has certification to perform assigned tasks. In addition, importance of equipment and systems necessary for the task and proper standard training and exercising the plans and taking corrective actions among the deviations resulting in the plans are the activities included in the emergency preparedness (Bullock, Haddow, & Haddow, 2008). More over emergency preparedness in an organisation can be improved by Optimizing staff performance in an emergency situation and by improving long term response management. Apart from this techniques to mitigate financial loses in time of crisis is also very essential in improvising the emergency preparedness.

The following table elaborate the various dimensions or the elements of preparedness of the organisation and its associated activities.

Table 1: Dimensions of Preparedness and Its Associated Activities

Dimensions of Preparedness	Associated Activities
Hazard Knowledge	Conducting hazard, impact, and vulnerability assessments. Using loss estimation software, scenarios, and census data. Understanding potential impacts on facilities, structures, infrastructure and populations. Providing hazard information to diverse stakeholders.
Management, Direction and Coordination	Assigning responsibilities. Developing a division of labor and a common vision of response-related roles and responsibilities. Forming preparedness committees, networks. Adopting required and recommended management procedures (e.g., National Incident Management System). Providing training experiences, conducting drills, educating the public.
Formal and Informal Response Plans and Agreements	Developing disaster plans, evacuation plans, memoranda of understanding, mutual aid agreements, collaborative partnerships, resource sharing agreements. Participating in broader and more general planning arrangements (e.g., neighborhood and community preparedness groups, Urban Area Security. Initiative regional plans, industry-wide preparedness initiatives).
Supportive Resources	Acquiring equipment and supplies to support response activities; Ensuring coping capacity. Recruiting staff. Identifying previously unrecognized resources. Developing logistics capabilities.
Life Safety Protection	Preparing family members, employees, others to take immediate action to prevent death and injury, e.g., through evacuating, sheltering in place, using “safe spaces” within structures, taking emergency actions to lessen disaster impacts on health and safety.

	Containing secondary threats, e.g. fire following earthquakes.
Property Protection	Acting expediently to prevent loss or damage of property. Protecting inventories, securing critical records. Ensuring that critical functions can be maintained during disaster. Containing secondary threats.

Source: Sutton & Tierney (2006)

2.2 BUSINESS CONTINUITY PLANNING (BCP)

Business continuity planning has been widely accepted by most organisations of all sizes as being essential strategic management tool (Goyal, 2004). There are two terms namely, Business Continuity Planning (BCP) and Business Continuity Management (BCM) which need to be described before moving broadly into the BCP concepts. Business continuity plan is the advance planning for the future losses and creating strategies to recover from them in case of an emergency or disaster. On the other hand BCM are the management disciplines, and processes to provide a framework for building organisational resilience ensuring the continuous operations of all business functions (Fournai, 1998). In this context it is also very necessary to distinguish the terms disaster recovery planning and the business continuity planning where Business Continuity Planning relates to ensure that an organisation can survive an event that causes interruption to normal business processes and Disaster Recovery Planning is the process that takes place during and after an organisational crisis to minimise business interruption and return the organisation as quickly as possible to a pre-crisis state (Moore & Lakha, 2006).

The implementation of a continuity plan and restoring of business in the event of an emergency is depending on the successful interaction of various components and strength and effectiveness of a BCP can be decreased by its weakest component (Federal Financial Institution Examination Council, 2003). It was identified that BCPs and tested on a basis without considering the effectiveness of the plan have been established (Hearnden, 1995). The business continuity coordinator or team facilitates needs to identify risk and take actions to implement risk mitigation strategies across business areas. Internal and external factors of business environment will have negative impact on BCP (Federal Financial Institution Examination Council, 2003). Even though in organisations BCP have been established they largely focused on information technology but a fully integrated BCP was examined by Hearnden (1995) focusing on five areas including loss of buildings, loss of key personnel, loss of proprietary information, loss of telephone system and loss of corporate stationery. Creating a successful BCP is very essential but lack of understanding of critical issues regarding people at the board level leads to inefficient BCP (Alexander, 1994).

According to Pitt and Hinks (2001)critical aspects of business continuity planning are carrying out BCP enterprise wide basis, ensuring full business impact analysis and risk assessment, validating BCP through testing, updating BCP to respond changes and subjecting BCP to independent audit. Implementation of BCP includes phases such as project initiation, risk assessment, design and development of the BCP, creation of BCP, testing, practicing and updating (Heng, 1996). These are the phases of BCP which will make it efficient.

1) Project initiation
This is the phase of establishing business continuity planning objectives and the requirements of the plan with approval of the senior management (Goyal, 2004). In this stage the personnel responsible for BCP should inform the executive on the critical areas of the core company, and should also be able to relate these to the business-critical aspects of the business support functions affected collaterally by a disaster (Fournai, 1998).

2) Risk assessment

In this phase impacts on business by nonspecific events are identified. Identification of critical functions and the prioritation too happen during this phase. Maximum allowable downtime for critical business processes, recovery point objectives and backlogged transactions, and the costs associated with downtime are also identified during the phase (Federal Financial Institution Examination Council, 2003).

3) Design and development of BCP
This phase includes the main things that need to be addressed in the BCP such as emergency response procedures, communication procedure, restoration procedures and external support (Goyal, 2004).

4) Testing and revision of BCP
Testing the BCP is an excellent way to assess the strengths and weaknesses of plan to gain an appreciation of the inherent safety factor in the operations for the formalisation of better internal communication and the scope to test the own company and resources (Paton, 1999).

5) Maintenance and updating
According to Pitt & Goyal (2004) in this phase experiences due to the BCP practice and shortfalls documented are incorporated into plans while addressing issues such as BCP review criteria and objectives, schedules and programme of review and plan distribution and security.

After the implementation, it is essential to know the outcomes. According to Ramesh (2011) final outcome of BCP exercise will be a set of measures to prevent disasters, BCP operational to handle the situation and a plan which acts as a road map when disaster strikes. According to Lam (2002) changes that will take place in the future in business continuity planning are inclusion of business threat to the survival of business, inclusion of physical safety of employees, decentralization of business operations and the expansion to include the regional impacts. Apart from this, how the goals of business continuity planning can be quantified, and they are quantified in terms of recovery time objective, recovery point objective, performance degradation, risks involved in measures and the cost of implementation (Aacharya, Gastmans, & Denier, 2011). More over Lam (2002)have addressed regarding the business continuity awareness too which includes identifying and manging the business continuity requirements, emphasising business continuity as one of the key concept, holding awareness workshops, and BCP review meetings.

BCP for recovering facilities should consider an alternative for location with relevant size and capacity and required amenities to recover critical business functions the plan should include logistical procedures for moving personnel to the recovery location, in addition to steps to obtain the materials (Federal Financial Institution Examination Council, 2003). Importance of business continuity planning in making a business resilient has also been included in the standards such as ISO 22301 (Societal Security - Business Continuity Management System –requirements), ISO 22313 (Societal Security – Business Continuity Management System –Guidance) and PAS 2015 (Framework for Health Services Resilience). In order to ensure the success of the organisation while ensuring the business resilience emergency preparedness and business continuity planning will enhance the stability of the organisations. The success of an organisation's emergency preparedness and business continuity management relies on the input and experience of its staff as they need understand the organisation, its processes and the environment in which it belongs (Hiles, 2004).

3. Conclusions and Way Forward

Recent disasters all around the world have made the organisations globally recognise the importance of emergency preparedness and business continuity planning. Emergency preparedness and business continuity planning contribute immensely to the success and stability of the organisation. The entire organisation in a stage would undergo risks, to mitigate them business continuity planning techniques

and emergency preparedness techniques are the essential tools for the organisation. According to the literature reviewed emergency preparedness will help to react in emergency situations without getting panic and it is a process which helps to adapt to emergencies. On the other hand business continuity planning will help the organisation to prepare the continuity plan to ensure the proper operation of critical functions of the organisations. In the current context competition among organisations is very high and therefore organisations need to ensure their stability in the organisation to reduce future losses.

Business continuity techniques are essential strategic making tool which can be short term or long term depending on the policies of the organisation. Different researches about business continuity techniques include techniques to evaluate the critical functions comprising of suitable criteria relevant to them. Even though the concepts of emergency preparedness and business continuity plan among organisations has widely recognised after the terrorist attack in the United States of America, globally there is no clear picture about the concepts in Sri Lanka. Therefore the next step in this research is to find the current practices of emergency preparedness and business continuity planning in Sri Lanka and the parties involved in the process and to analyse the importance of emergency preparedness and business continuity planning.

And Facilities management covers a wide range of facility services and the management of which can contribute to the relative success or partial failure of an organisations business. Therefore, there could be another way to direct future research to study the involvement of Facilities Manager in BCP and EP Sri Lankan context.

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TOTAL BUILDING PERFORMANCE MANDATES IN BUILDING EVALUATION: A REVIEW

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Abstract
The essence of buildings within the turbulent environment is highly influenced on the efficiency and effectiveness of occupants' performance and comfort. Herein, a re-examination of occupant comfort can offer the impetus for thinking out of the box from general occupant needs to seeking improved quality of life. Creation of user satisfaction can be achieved through the involvement and sophisticated interplay of Total Building Performance Mandates (TBPMs). However, building owners tend to maximise economic gain through the production while ignore the occupant comfort within the built environment. Thus, the aim of this study is to fill the research gap by critically reviewing the relevant literature on TBPMs. A comprehensive literature review was directed to explore the TBPMs (Spatial Performance [SP], Thermal Performance [TP], Indoor Air Quality Performance [AIQP], Acoustic Performance [AP] and Visual Performance [VP]) and acceptable requirements of TBPMs (physiological, psychological, sociological and economic). Further, the paper recognised TBPMs diagnostic measures, indicators and potential health effects. The findings of this study could be used by practitioners as a basis in understanding the BPMs that would be of use in making effective decisions during their endeavours to enhance the total building performance and comfort.

Keywords: *Spatial performance, Thermal performance, Indoor air quality performance, Acoustic performance and Visual performance.*

1. Introduction

In general, buildings are constructed with two main intensions: a precise function, and aesthetic quality. Nonetheless, comfort within the building is one of the undoubted considerations (Celik, 2010). Accordingly, Total Building Performance Mandates (TBPMs) play a dynamic role in delivering comfort to building occupants while achieving building functionality (Lai & Yik, 2009). The term TBPMs is comprised with five mandates namely, Spatial Performance (SP), Thermal Performance (TP), Indoor Air Quality Performance (AIQP), Acoustic Performance (AP) and Visual Performance (VP). These mandates mainly focus on building occupants' requirements and comfort. Moreover, building related pollutions, waste generation and energy wastage can be minimised through proper integration of TBPMs to building design as well as to the building operation (Wang et al., 2010). However, still there appear to be confusions and lack of consideration regarding TBPMs. Hence, this paper is aimed at reviewing the existing literature to identify and explore the concept of TBPMs, five main mandates and considerations of TBPMs to achieve occupants' comfort and satisfaction within the buildings.

2. Research Methodology

A systematic literature review is a vigorous research method that is capable of synthesizing the existing knowledge on the subject, generating new in-sight on a wider scale and recognising novel schemes for future research (Sengers et al., 2019). To accomplish the above mentioned aim of the study, a systematic literature review was utilised. The research methodolo-gy adopted to conduct the systematic literature review is summarised in Figure 1, which is supported by studies of Kilubi (2016).

As illustrated in Figure 1, this study followed seven steps. Intention of step 1 was to formulate specific research focus based on gap identified in the ex-isting knowledge. According to step 2, 'Google scholar', 'Science direct', 'Scopus' and 'Emerald' were used as widely involved domains for conduct review papers (Rathnayake et al., 2020; Fasna & Gunatilake, 2019). Search was conducted for the period from year 2000 to 2020. Through the abstract screening, 48 articles were filtered and finally 32 articles were involved for full text review process. Collected data were analyse using content analysis.

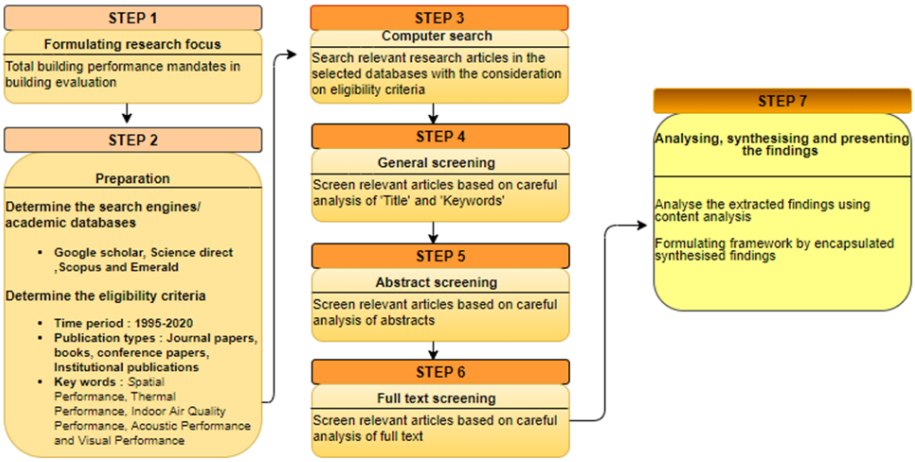

Figure 1, Systematic literature review process

3. Total Building Performance Mandates

Providing comfort to the building occupants is the main essence of a build-ing (Celik, 2010). Therefore, the concept of Total building performance (TBP) was developed within Public Works Canada, Architectural and Building Science Directorate between 1981 and 1985 (Huang et al., 2012). Within the setting of built environment, four conditions should be emphasised for the ultimate success of the application of TBP, namely; occupant satisfaction, organisational flexibility, technological adaptability and environmental, and energy efficiency. TBP can be evaluated and measured through BPMs. According to Celik (2010) BPMs play a vital role in providing comfort to the building occu-pants. Mandates can be described by using two different aspects: funda-mental mandate (refers as building enclosure integrity which protect build-ing's visual, mechanical and physical properties from environmental deg-radation) and series of mandates related to occupancy requirements and comfort (SP, TP, AC, VP and IAQP).

3.1. SPATIAL PERFORMANCE

Spatial performance (SP) concept is known as the functional performance concept in TBPMs (Pheng et al., 2008). In general, main concern of SP is to evaluate ergonomics arrangement of a specific space to gain maximum satisfaction to the respective occupants. According to Magani et al. (2020) spatial arrangement should consider, the work performed, type of furniture and equipment used, the area of storage required and number of occupants. There are main five guidelines which have drafted as main five considerations for SP which involve for display the sign of elevated status. Firstly, achieving ergonomic comfort to fulfil occupants' comfort requirements. Sometimes building designs cannot be fulfilled all the ergonomic requirements of the occupants but theory identifies that ergonomics comfort is to fulfil the greatest possible level of comfort for the greatest number of occupants. Secondly, ensuring privacy. Building occupants do not prefer any disturbances to their privacy, therefore, designers can show the trust by providing enough privacy to the working spaces and this can boost productivity of the occupants (Peng et al., 2020). Thirdly, space conservation. In any workplace, space can identify as a constraint and only limited area available for use. Fourthly, systematic arrangement of space. Available space of the building should be arranged in a systematically, on the other hand, non-systematic space arrangement leads to confusion (Wang & Chiou, 2020). Finally, interaction between users. Space should promote human interactions and should not prevent their communication. Accordingly, walls that use to separate space should not prevent human interaction or should build more avenues to have occupant's interactions with one another (Wang & Chiou, 2020).

3.2. THERMAL PERFORMANCE

The condition of mind which express the satisfaction with the thermal environment is referred as thermal comfort or TP of the building (Huang et al., 2012). TP refers to three components; temperature, relative humidity and air movement (Silva & Ghisi, E, 2020). Further, Frantczak and Wargocki (2011) explained that thermal environment is a combination of four physical variables (air temperature, mean radiant temperature, relative air ve-locity and air humidity) and two variables related to people (clothing and active level). Frequency of the operative temperature (FOT), intensity of thermal discomfort (ITD) and fluctuation of thermal discomfort (FTD) can be pointed out as three indicators for TP of buildings. FOT identifies the most frequent temperatures for a particular building (Sicurella et al., 2012). Further, FOT is useful in comparing operative temperatures with those acquired with other building solutions. Experts have recommended to conduct daily basis analysis for operative temperatures especially when evaluating the movable shading devices. ITD is referred to the difference between current operative temperature and the upper limit of comfort or the lower limit of comfort. ITD parameter is constructed using indoor air temperature, upper limits of temperature and lower limits of temperature. Discomfort in terms of over cooling or over heating can be seen in high ITD situations (Silva & Ghisi, E, 2020). FTD is defined as a way to distinct different situations of frequency of thermal discomfort. Further, FTD can be defined as a ration of the ITD to the length of the period when thermal discomfort is actually occurred (Sicurella et al., 2012).

3.3. INDOOR AIR QUALITY PERFORMANCE

According to United States Environmental Protection Agency's comparative risk studies, indoor air is ranked as one of the top five environmental risks related to public health (Lai et al., 2009). IAQP means air in which there are no known contamination at harmful concentrations and with which a substantial majority (80% or more) of the occupants exposed, do not express dissatisfaction. According to ENV Guide-lines, acceptable concentration of carbon dioxide is 1000 ppm for indoor space (Nazaroff, 2013). Carbon dioxide concentration beyond 600 ppm may cause physiological effect, such as sensation of breathing difficulty, fatigue drowsiness, loss of productivity, absenteeism at work, lack of concentration and sick building syndrome [SBS] (Nazaroff, 2013). In detail, SBS is defines as the condition of at least 20% of the occupants of the building experience symptoms of illness for a period of two weeks or longer, but the source of symptoms cannot be determined.

3.4. ACOUSTIC PERFORMANCE

Acoustic comfort is defined as a state of contentment with acoustic conditions (Wong & Jan, 2003). On the other hand, noise is defined as un-wanted sound that leads to nuisance in the living or working environment (Peters, 2013). Especially this acoustic concept deals with noise and vibration. Unwanted sound which identify by listener can be named as noise and noise is mainly defined on listeners' subjective behaviours. Accordingly, sound enjoyed by one person may be annoying noise in another. AP defers from building's orientation, quality of materials used, workmanship and interior layout of the space. Acoustic measurements can be used for three different purposes, namely, to indicate the effects of exterior noise from neighbouring working stations within the specific building, to indicate the ability of the working station in exterior noise reduction and to indicate the effects of traffic noise on work perform (Wong & Jan, 2003).

3.5. VISUAL PERFORMANCE

VP is defined as a subjective status of visual well-being induced by the visual environment. VP of the building has a direct relationship between com-fort as well as energy consumption of the building. VP is not highly standardised as thermal comfort since it depends on the daylight, screens and glazing that filter the daylight and visual task (Nag, 2019). Luminance distribution, illuminance and its uniformity, glare, colour rending, colour of light, amount of daylight and flick are used to describe the qualities of VP. Illuminance measurements used to evaluate VP and different illuminance levels can be

recognised for different tasks and different functional areas of the building (Nag, 2019). Glare can be identified as a common problem in VP. Daylight is a vital consideration for VP and it is basically assessed through daylight factor (Fasi & Budaiwi, 2015). According to authors, considering only about the daylight factor is not sufficient to evaluate daylight availability for VP. Therefore, due consideration should be given to assess potential natural lighting and shading devices.

4. Diagnostic Measures of TBPMs

TBPMs have their own characteristics, even though they inter-play within the built environment. Therefore, different parameters, tools and techniques are used to evaluate the level of TBPMs in the built environment. Table 1 tabulates the diagnostic measures of TBPMs.

Table 1, Diagnostic measures of BPMs

BPM	Sub parameters	Unit	Tool/ technique
SP	Distance	M or m^2	Measuring tape
TP	Temperature	^oC	Thermometer Humidity & temperature meter
	Relative humidity	%	Humidity & temperature meter Psychrometer or hygrometer
	Average air movement/ velocity	m/s	Anemometer
IAQP	Carbon dioxide level	ppm	CO_2 meter Metrosonic Indoor air quality meter Optical particle counter Condensation particle counter
	Dust level	Mg/m^3	Grimm dust monitor
AP	Ambient noise level	dBA	Sound level meter Acoustic analyser
	Sound intensity (I)	W/m2	
	Sound pressure	Pa	
	Sound power (P)	W	
VP	Lighting level / illuminance	Lux	Light-meter/ lux meter Illumination meter

Source: (Bano & Sehgal, 2019; Kotzias & Pilidis, 2017; Wong & Jan, 2003)

5. Conditions of TBPMs

Four main conditions can be defined as main qualities that should deliver through successful integration of TBPMs to building design (Wong & Jan, 2003). Moreover, these conditions known as benchmarking criteria of five TBPMs. These performance mandates are affected with four conditions of acceptability, namely; physiological, psychological, sociological and economic.

Four conditions directly applied with SP. Physiological conditions deals with ergonomic comfort, safety and health concerns related to SP. Psychological conditions of SP concern about conditions which affects to privacy and distractions (Bano & Sehgal, 2019). Especially, building designers must design by considering disable occupants' needs and wants. Sociological conditions in SP concerns about individuals' needs such as proper communication and interactions (Markoska & Lazarova-Molnar, 2019). Space arrangement should properly facilitate communication needs of occupants and should not stifle the interaction of the occupants. Economic conditions for spatial quality must be covered through proper arrangement of space while maximise benefits to building owner and occupants. Physiological conditions of TP, concern about achieving physical thermal comfort through

engineering and other administrative controls. Providing individual controls for thermal condition and incorporate healthy plants to working environment are some of the examples for fulfilling psychological conditions. Providing comfortable uniform for work is identified as an essential need under sociological aspect. When designing and operation thermal system, energy conservation is a main consideration with the installation of green roofs (Papadopoulos, 2016).

Ensure air purity through proper building envelope design and good ventilation system are considered under physiological conditions of IAQP (Kotzias & Pilidis, 2017). To ensure good mental health of occupants, efficient ventilation and air changes should present. Non-smoking concept is a common and famous initiative under the sociological condition of IAQP. In-corporate energy saving mechanisms to ventilation system is must to fulfil economic needs. To protect occupants from hearing damages, buildings need to be free from excessive noise and working environment need to allow proper communication with speech clarity are examples for physiological conditions (Peters, 2013). Psychological conditions design to support mental health and therefore there should not be excessive noise that could affect building occupants (Wessels & Basten, 2016). Sociological conditions manage well-being of the community within which the occupants act. Economic conditions of AP aim to allocate necessary resources in the most effective and efficient manner to fulfil users' needs within the wider social context (Peters, 2013). Physiological conditions of VP is essential since it may contribute to serious health issues. Integrate cheerfulness, spacious, alive condition, calm and intimate through proper VP are considered under psychological conditions. Selection good quality lighting system whiling managing budget requirements are essential for economic performance of IAQ (Kotzias & Pilidis, 2017). Table 2 explain the summary of building performance man-dates related with four acceptable conditions.

Table 2, Conditions of TBPMs

TBPMs	Physiological conditions	Psychological conditions	Sociological conditions	Economic conditions
SP	• Ergonomic comfort • Handicap access • Functional servicing • Easy access to service systems for maintenance • Distinct space division with appropriate transition	• Privacy for occupants. • Systematic arrangement of space. • Habitability beauty, calm, excitement, view. • Changeable spaces. • Wayfinding through innovative but unambiguous signs	• Interaction of occupants. • Wayfinding • Functional adjacencies. • Easy access to sky garden where could provide private space.	• Cost. • Energy consumption and efficiency • Conversion of materials and other resource. • Space conservation.
TP	• Engineering controls • Administrative controls • No numbness, frostbite, no drowsiness, heat stroke • Measures to reduce heat island effect	• Healthy plants • Sense of warmth • Individual control	• Flexibility to dress with the custom.	• Energy conservation • Green roofs to reduce thermal load and collect rainwater
IAQP	• Appropriate architectural design and elements • Space planning • Ventilation and air change efficiency • Materials selection and specification • Building envelope and openings • Air purity	• Quiet. • Soothing; activity • Excitement 'alive'	• No irritation from neighbours smoke or smells.	• Energy conservation • Separate air ventilation from cooling system which lead to save energy
AP	• External noise	• Appropriate quantity of	• Internal sound	• Energy conservation

	minimization • Internal sound minimization • Vibration minimization • Speech clarity. • Music enjoyment	lighting. • Building envelope and building orientation • Design of openings • Cheerfulness, calm, intimate, spacious, alive	minimization • Building services • disturbance • Vibration minimization. • Privacy and communication.	

Source: (Kotzias & Pilidis, 2017; Papadopoulos; 2016; Markoska & Lazarova-Molnar, 2019; Wong & Jan, 2003)

6. Potential Health Effects and Measures to Improve the Condition of TBPMs

People spend around 90% of their time in both public and private indoor environments for various building functions whereas, exposure to negative effects caused due to poor attention on the conditions of BPMs (Cincinelli & Martellini, 2017). The health effects of poor performance of BPMs range from short-term effects to long-term effects. Exposure to unacceptable lev-els of pollutants or situations, not only result in health issues but also result dangerous casualties and fatalities. Therefore, potential health effects of BPMs and measures to overcome the identified effects were evaluated as demonstrated in Table 3.

Table 3, Health effects of and measures to improve the condition of TBPMs

TBPMs	Health effects of poor BPMs	Measures to improve BPMs
SP	• Carpal tunnel syndrome • Repetitive stain injury • Ergonomic problems • Musculoskeletal disorders	• Ergonomically arranged work stations with the ability to replacement from sitting to standing positions • Create collaborative spaces, as well as areas to relax and de-stress
TP	• Increased irritability • Loss of concentration • Heat edema • Heat rashes • Heat cramps • Heat stroke	• Use a mechanical ventilation system • Use insulation techniques (cavity walls, loft insulation, internal/ external wall insulation) • Install double or triple-glazing
IAQP	• Watery eyes • Fatigue • Dizziness • Headaches • Upper respiratory congestion • Nasal congestion • Epistaxis • Lung diseases	• Implement 'no-smoking' policy • Develop green cleaning protocol • Install air-filtration • Incorporate healthy office plants • Allow air infiltration • Use non-hazardous chemicals for process
AP	• Hearing impairment • Tinnitus • Heart diseases • Hypertension • Annoyance • Birth defects	• Add additional mass and insulations to wall partitions • Use sound absorbents for suspended ceilings • Use acoustic insulation wall boards • Proper maintenance and fixing of machines
VP	• Eyestrains • Headaches • Neck, back and shoulder strain • Depression	• Measure the average illuminance throughout the workplace and compare with recommended levels • Maximize natural lighting • Correct insufficient light • Mitigate glare issue by using small low-intensity light fixtures rather than one large high-intensity light fixtures

		• Correct contrast issue • Conduct detailed lighting survey

Sources: (Cincinelli & Martellini, 2017; Huang et al., 2012; Wang, 2020; Schibuola, L., & Tambani, 2020)

7. Conclusion

This study elaborated a big picture of the BPMs in building evaluation along with the respective concept illustrations, diagnostic measures, acceptable requirements and potential health effects and measures to improve the condition of BPMs. These five BPMs can be recognised as a series of mandates related to occupancy requirements and comfort. Among the five BPMs, SP knowns as the functional performance mandate and IAQP was revealed as one of the top five environmental risks related to occupant health and well-being. Besides, the paper presents different indicators and diagnostic measures for BPMs that would be useful in maintaining proper conditions in building environment. In addition, a comprehensive list of acceptable requirements for each BPMs that can be integrated as the benchmark criteria were also presented in the study. The findings of this study could facilitate industry practitioners and other researchers to have a better understanding of concepts of BPMs, indicators, diagnostic measures, health effect and measures to improve conditions of BPMs, which would be use for them during their endeavours to enhance building performance of their facilities and further researches. Though through compiling different literature sources, relevant acceptable requirements could be recognised, which is found to be vital in making fruitful decisions regarding BPMs. Hence, assessing TBP that could be gained through proper integration of BPMs found to be a worthy research area.

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UNDERLYING REASONS BEHIND THE SUSTENANCE OF RAGGING IN SRI LANKAN UNIVERSITIES: *Findings from a state university in Colombo, Sri Lanka.*

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Abstract
Ragging is a deep-seated long-lasting social practice found in the state university system of Sri Lanka. Considering the negative, damaging impacts on physical, psychological, social, cognitive and behavioural aspects of undergraduates, it has been identified as a punishable offence under the Prohibition of Ragging and other forms of violence in educational institutions Act, No. 20 of 1998. Despite the array of harmful effects, ragging has evolved during the past five decades and sustained thus far amidst severe punishments imposed. The objective of the current study was to identify the underlying deep-rooted reasons behind sustenance of ragging in state universities with reference to a selected university (UOX) in Colombo, Sri Lanka. In-depth interviews were conducted with a heterogeneous sample (n=20) of volunteers. The study exposed an interconnected feeding system comprised of a minority of significant personnel among freshers, seniors, student unions, staff, administration, industry and political parties who play a decisive role in justifying the need and thereby support the sustenance of ragging. These findings may enable university authorities to find creative and innovative solutions to combat this menace to create a conducive academic environment for the future student community of State Universities in Sri Lanka.

Keywords: *ragging, state universities, conducive academic environment*

1. Introduction.

Ragging has been reported to have caused severe impacts to undergraduates ranging from psychological imbalances/disorders (anxiety, stress, depression, phobia, trauma, PTSD, ignominy, alienation, isolation, demoralization, detrimental impacts on personality, repressed unpleasant memories), physiological damage (physical injuries, rhabdomyolysis, hemolysis, heart attacks, deaths) to long term disabilities and even suicide (Bandara 2002, Athukorala 2018, Jayarathne 2019). Several suicides and brutal murders are among the ragging related deaths reported in the universities while some are unresolved yet but suspected to be connected to ragging (Daily Mirror, 2016). Ragging related abusive conduct further has unfortunately resulted in many students dropping out of university education while many others eligible for University education refraining from getting enrolled in state universities.

Considering its damaging nature, ragging is officially prohibited in universities/educational institutions and is a punishable offence under the Prohibition of Ragging and other forms of violence in educational institutions Act, No. 20 of 1998 (Jayasinghe,2017). No matter how much ragging is harmful, it has been sustained to date unabated at academic institutes despite severe punishments stipulated by the act having being imposed (Jayawardhana and Gamage 2017 and Bandara, 2002, p.1). According to the Minister of Higher Education (Daily Mirror, 2018), even if the ragging act of 98 provides for the students found guilty of ragging to be sentenced to ten years rigorous imprisonment, it has not been heard of students meted out any prison term for the past 20 years despite ragging incidents reported and students being arrested occasionally.

On the other end, Dewasisri cited in (Jayasinghe, 2017) clarifies that, University authorities don't have a proper mature strategy to counter ragging. He highlights the necessity for a zero-tolerance ragging policy and proposes that ragging should be isolated and dealt with, but without imposing restrictions on other student activities which meaningfully nourish their experience as an undergraduate of a particular university.

The current situation of ragging in Universities is disgraceful. As highlighted by Wajahat (2013) a noticeable increase has been observed in ragging all over the world, especially in Southern part of Asia

including India, Bangladesh, Pakistan, and Sri Lanka.

1.1 OBJECTIVES OF THE STUDY

There are many reasons behind the sustenance and continuation of ragging (Rajasingham, 2017). In view of this, the proposed investigation will look in to the reasons behind the sustenance of ragging amidst all the combatting mechanisms implemented so far. The study will attempt to seek

- The background, nature and prevalence of ragging
- Main agendas and expected outcomes of ragging
- Types of harassments caused due to ragging
- Underlying reasons for ragging to persist.

2. Review of Literature

Ragging was never heard of in the history of the pioneering educational institutions like '*pirivenas*' in the Sri Lankan context. Following the tradition of British universities, 'ragging' entered our vocabulary subsequent to the introduction of university education in Sri Lanka (Bandara, 2002, p. 11). Taking inspirations from the universities, ragging expanded to vocational training institutes, central colleges, government schools, teacher training colleges, technical colleges, national colleges of education, forces, police services and many other places causing negative impacts to the student community as a whole (Bandara, 2002, p. 11).

2.1 DEFINITIONS FOR RAGGING

As defined by Rajasingham (2017), ragging is a deep-seated social practice. Elaborating this sociological dimension, Gamage (2017) identifies this to be linked with the general stratification of society along various hierarchies and power imbalances between those who wield power and those who are the subjects of such hierarchies. Highlighting another facet, Gamage (2007) further identifies ragging as a phenomenon that has arisen as a result of the sexual and romantic deprivations of male students who are away from their usual places of residences or birthplaces. Daily Mirror (2016) highlights that the temptation for ragging is nothing other than a psychopathic condition. Involvement of sexual abuse in many ragging cases clearly points to the sadistic side of the ragger's mentality. As explained by psychologists and psychiatrists' students with psychological imbalances; mania, sadism, body dysmorphic, loathing, Anti-social personality, abused childhood, separation anxiety, personality disorder …etc are the ragging perpetrators (Athukorala, 2018 and Jayarathne, 2019). The ones who are underserved, underprivileged, discriminated, cornered during schooling/from society use ragging as an avenue to transfer their pressure to a weaker target (as a defence mechanism) while attempting to gain authority and recognition (Athukorala, 2018). Bringing another dimension in to light, Gamage (2020) explains ragging as a political enterprise, an instrument of political indoctrination which is used by a certain political party to gain recruits for demonstrations, picketing, etc and to raise funds for their political activities.

2.2 FORMS AND NATURE OF RAGGING

Ragging can be seen in one or a combination of modes mentioned below in the Sri Lankan universities.

- Verbal harassment: Verbal aggression, shouting, scolding, bullying, scolding over the phone, obscenity, filth
- Physical harassment: Forced to engage in student group activities, events, physical exercises, forced exposure to severe weather
- Psychological harassment: stalking, following, humiliating, staring at, cyber harassment/bullying/blackmailing

- Sexual harassment: Unwelcome sexual comments or jokes, touching in a sexual manner without consent, forced to write or say obscene words, forced to expose private / sexual parts of the body, watch pornographic material, perform sexual acts that are degrading, forced sexual acts without consent

2.3 EXPECTATIONS OF THE PERPETRATORS BY THE ACTS OF RAGGING

Raggers represent a minority compared to the overall student population in any university. Literature establishes following as key expectations of ragging (Athukorala 2018 and Jayarathne 2019).

- Mental satisfaction
- Releasing stress /compulsions
- As a means of catharises; vent ones suppressed impulses, frustrations, unresolved childhood conflicts
- Dominance; sense of superiority, seeking authoritative power/leadership/recognition
- Sublimation- Ragging as a defence mechanism; coping of internal conflicts/impulses in a socially acceptable form
- Gratification of sadistic tendencies: opportunity to satiate one's sadistic demands
- Projection of sexual desires/ sexual pleasure
- Fulfilling hidden abnormal sexual desires
- students who were ragged by their seniors transferring the pressure to their juniors; "I give back what I got before"
- Getting rid of peer pressure
- Fulfilling political agendas

Ragging perpetrators (seniors) under the guise of 'orienting' first year students (freshers) and making them 'conditioned' to the new surroundings, torment freshers ranging from undisciplined haughty speech to violent physical activities which can be equivalent to torture (Devapriya cited in Bandara, 2002). On the other hand, the pro-ragging staff members and students are hesitant to reveal the reality behind ragging or accept the fact that ragging is persisting to safeguard their popularity. However, it is vital for this minority to understand that they will be un-popularized not because they reveal the truth behind ragging but because they safeguard the raggers (Devapriya cited in Bandara, 2002).

As a matter of fact, ragging has evolved during a period of more than 50 years and exists in the university system up to date regardless of all the punishments and disciplinary actions imposed. The sustenance of ragging this long may be supposedly due to certain deep-rooted core values transferred from generations to generations by a certain group of people of a certain caliber. Further, there are concerns on the ineffectiveness of existing methods of complaining about ragging and violence to the university authorities and subsequent actions taken on ragging within the university system. As responsible academics and citizens of the country, it is vital to find solutions/ mechanisms to minimize and eliminate ragging /violence to make universities safe, healthy and conducive for future generations. Further, it is vital to identify and extract the useful, beneficial co-values of ragging (if any) and develop innovative and creative mechanism in achieving such objectives in a totally harmless yet meaningful and effective manner. In line with this, the current investigation probes in to the underlying reasons behind the sustenance of ragging in Sri Lankan universities, selecting a state University in Colombo, Sri Lanka as a case study.

3. Research design

3.1 ACKNOWLEDGEMENT

The current investigation was executed as a follow up inquiry catalysed by the study on "Ragging and Gender Based Violence (SGBV) in Sri Lankan University system & implementing / proposing

interventions and mechanisms for combating ragging and sexual and gender-based violence in the Sri Lankan university system", embarked upon by the UGC from July 2018 to January 2019 (funded by UNICEF). Aforementioned study included a paper and pencil survey, an online survey (in three languages) as well as in-depth interviews and focus group discussions for both staff and students. This was conducted in 8 Universities around the country and the university considered in the current investigation (hereinafter mentioned as UOX) was within the sample selected by UGC as detailed below and coordinated by a research team appointed by the vice chancellor. The details are as below.

Students' Survey – n = 1029 (Male 60%, female 40%)
Staff survey – n = 181 (Male 40%, female 60%)
In-depth interviews (both staff and students representing all faculties, departments, divisions) – n = 12
Focused group discussions – n =8 groups

The responses of the above study indicate the prevalence of ragging and harassments at UOX, though not in a significant level. For instance, verbal aggression (23%), name calling (27%) and other verbal acts (50%) have been identified by the subjects as prevailing. It was seen that there is a psychological impact over undergraduates via spreading rumours (10%) and pressure coming from others controlling what students do (9%). The responses, though insignificant in numbers, indicate the prevalence of unpleasant experiences at some of the buildings/locations of UOX; canteens (27% total), university grounds (14% total), labs/lecture halls (11%) and hostels (7%). Though (99%) of the subjects deny their involvement in ragging, 26.76% of subjects have agreed that they have been ragged during their stay as an undergraduate which clearly signifies the prevalence of ragging at UOX. The overall responses with reference to acts of violence based on sex/gender at UOX was insignificant. However, treating differently due to gender (10%), staring at them making them feel uncomfortable (10%), offensive remarks on one's physical appearance (7%), repeatedly told sexual jokes/stories (5%) and whistling/calling/hooting in sexual way (5%) were identified by some respondents though they do not represent significant numbers.

The study conducted by UGC provided opportunity to have an in-depth understanding on the nature, frequency, process and the hot spots of ragging with reference to UOX, signifying the worth to investigate the underlying reasons behind its prevalence in order to formulate remedial actions. Accordingly, the current investigation was conducted as a follow up study to expose UOX specific parameters behind the prevalence and continuation of ragging.

3.2 METHODOLOGY

Considering the sensitiveness of the subject matter, achieving the validity and the credibility of responses from students was a challenge. It was noticed that generally the students are reluctant to respond to online questionnaires genuinely due to the fear of getting traced. Though using paper and pencil seems a better alternative, executing such a survey in the Faculties while preventing student manipulations was seen as a difficult task. For instance, students can be organized under the influence of certain leadership (staff/students/union) in order to manipulate the responses to end up with favorable results. Accordingly, in-depth interviews were identified as the most appropriate data collection method in fulfilling the research objectives. On the other hand, identifying and incorporating the students who are willing to voluntarily provide genuine information on ragging was considered as the method for sample selection.

Consequently, a sample of undergraduates of both genders (n=20, 60% male and 40 % female, age: 20-25) of UOX representing all the faculties, student's clubs/societies, religions, sportsmen/sportswomen and academic levels were selected on a voluntary basis to conduct this qualitative study. The subjects were ensured at the onset of the interview that their identity will be kept confidential. Considering the necessity that the respondents should feel comfortable and sense privacy in reporting sensitive matters, the interviews were conducted in person by the investigator

face-to-face with the interviewee in an isolated room within the university premises during an average time of 45 minutes per interview. While maintain a continuous rapport with the interviewee the investigator noted down all the information provided.

4. Findings – A model for ragging at UOX

Aligned with literature, the subjects revealed below mentioned social, cultural, political and sex related facets as reasons for the prevalence of ragging at UOX.

4.1 BRAINWASHING; MISLEADING /FALSE INFORMATION GIVEN TO THE NEWCOMERS ("THELA GASEEMA")

False /misleading information provided to the freshers by the ragging perpetrators (seniors) regarding the overall academic environment at UOX seems to have an enormous impact on the sustenance of ragging. This brainwashing process is reported to occur systematically way before getting enrolled in to the university via *'kuppi'* sessions taking place in their hometowns (in temples, tuition classes) every weekend. These '*kuppi'* classes become the first source of information for most of the freshers to come to UOX. These sessions start soon after receiving their A/L results and initially take the form of providing genuine assistance in teaching the difficult subject modules (or modules which are difficult to comprehend as English being the mode of instruction at UOX) related to first year to attract the juniors. These sessions gradually convert in to brainwashing sessions identified as 'thela gaseeme'.

As clarified by the subjects, seniors not revealing the correct picture to the juniors from the beginning regarding the academic setup, role of academic staff, administration, seniors, student union …etc is a strategy for the sustenance and continuity of ragging. Academic staff/admin staff/ non-academic staff are being introduced as of 'NO USE'; not doing their job properly /maintaining a huge gap with students/ lectures are not comprehendible …etc. Accordingly, the freshers lose faith on academic and administrative staff unduly based on the misleading theories preached, and thereby severely impacting a healthy teacher-student's relationship. The seniors have been introduced as the 'saviors' of freshers and it is repeatedly preached that the juniors cannot survive university life without the support of seniors. The main points highlighted and exaggerated as benefits offered by the seniors as consequences of ragging are the assistance in academics; conducting 'kuppi' classes for difficult/less comprehendible subject modules mainly due to language problem, providing lecture notes, past papers, finding boarding places, finding industrial training places significantly for the marginalized students with financial, language and other difficulties. Consequently, strongly believing in these statements, the freshers get ragged tolerating all the physical, verbal and emotional harassments due to the fear of losing the connection of seniors and the said privileges offered by them. Further they have the fear of getting cornered in the batch, which extends throughout until graduation ('*ala weema'*).

It is true that the pro-ragging seniors help the juniors to find boarding houses on district basis. However, the hidden agenda would be the convenience in executing ragging activities on a district basis safely with no disturbance in those locations. Meanwhile the seniors do nourish a group of pro-rag followers from among the freshers.

The freshers themselves with time and experience at UOX realise that most the above statements have no validity. For instance, the subjects particularly stated that, once they proceed with university life there are seniors who genuinely help with academic activities on humanitarian basis. But they are definitely not the pro-ragging seniors who preached during rag season. Similarly, the past papers and reference material can be easily accessed through the library by any student.

Most of the ragging activities are carried out by the pro-ragging senior students under the guise of the key concepts like introduction, orientation, getting to know, skill development, social harmony, personality development, leadership training …etc with reference to freshers and the related events

are conducted with proper approvals from university academics and administration. Some of the events/gatherings organised for freshers with ragging as the underlying agenda are as below.

Conducting Events– 'Pirith', Trips, Sports days, Talent shows, New year festival 'Avurudu Uthsawaya', Social , bucket
Political campaigns – 'keta selaweema', pickets, events of student unions
Progress meetings – Early morning, overnight at gathering places
Ragging sessions; *"watha kireema'* – at the canteens, hostels, boarding places, safe houses outside university premises

4.2) MANIPULATING INFERIORITY / SUPERIORITY COMPLEX BASED DIVISIONS TO STRENGTHEN RAGGING ; THE SOCIAL DIMENTION

Inferiority complexes-based divisions of some of the students justify ragging and enhance long-term sustenance from level to level, feeding the notion that "We are there for the underprivileged" established by senior ragging perpetrators. Some of such divisions of privileged vs underprivileged are based on district of the school attended, difficulty in communicating in English language, difficulty in understanding Sinhala (by Tamil students), low z-score or being selected to follow degree programmes which are low in hierarchy within a faculty due to less GPA, difficulty in understanding certain technical modules due to following subjects in the arts stream during A/Ls , suffering with long term physical / psychological sicknesses, disabilities, issues in the physical appearance, family related issues, childhood related issues and relationship issues. Seniors justify that they do not allow freshers to speak in English language and enforce them to wear a prescribed dress code and to eat pre-defined food only from specific canteens to implant the sense of equity, equivalence in-between such divisions. It was revealed that most of these perpetrators share the common characteristics of coming from under privileged sociocultural, economic and family backgrounds, who had less opportunity and recognition in their schools/ society or having political agendas. Inferiority related ragging reduces confidence level of students, making them highly dependent on seniors while breaking down strongly built personalities with irreversible psychological impacts.

4.3 INFLUENCING FACTORS

The pressure coming from pro-ragging seniors, peers, political parties, student unions, ragging prone lecturers & administrators and industry is found to influence the continuity of ragging. This can be recognised as a systematised interconnected follow-up network. In such a context, while some seniors contribute to ragging with purpose and intention others are compelled to do so to survive the unbearable pressure coming from the said parties. It was reported that the initial ideas on ragging are implanted in freshers from some of the reputed tuition class teachers and then continues nearly a period of one year in hometowns since receiving A/L results and until getting enrolled for university. This gradually makes their minds conditioned to accept ragging as a norm. The majority of the freshers are scared and submit as commanded by the seniors without complaint thinking that this torture will last only during the rag season. However, it was reported that there are certain degree programmes at UOX that have ragging continuing up to the final year and monitored by the industry ensuring its sustenance.

4.4 CONTRIBUTION OF SOME OF THE STAFF MEMBERS

Unethical/unhealthy practices and behaviour of a minority of staff members have been identified to provide supportive testimony for the theories discoursed by raggers against the staff. Huge gap maintained between staff and students, difficulties in approaching to discuss academic and personal matters, difficulties in understanding / following lectures, unethical and unprofessional conduct (harassments, intimidation, aggressive behaviour) of some of the staff members and the conduct of ragging prone staff members are some of the highlighted issue by the subjects. Apart from above factors, lecturers being unfairly strict on 80% attendance, favouritism, taking personal revenges by

penalizing the students in their exams/ submissions….etc, some of the decisions made by inquiry committees /Board of Residence and Discipline which are unfair, being unfair/ unethical in assessments, statements made by some lecturers which indicate the power dynamics and signs of revenge from students (e.g. *" Don't forget that your degree is in our hands."*) were reported as other matters related to staff. Accordingly, the freshers have a fair confusion as to whom they can trust. The conduct of this minority of members has become a valid reason behind students not believing / trusting the staff while supporting and strengthening some of the theories behind ragging and its sustenance.

4.5 THE ROLE PLAYED BY STUDENT UNIONS

The dual and safe role played by the student union in balancing in-between the staff vs student affairs while fulfilling their political agendas is another reason for the continuation of ragging. While they try to convince the admin/staff that they stand against ragging, they have played a decisive role in generating fear and perpetrating ragging in the junior batches. Ragging can be identified as the innermost agenda of most of the events conducted/organized by the Union for the freshers in their respective faculties; New Year celebrations, pirith ceremony, fresher's nights, talents show, cricket matches, drama festivals etc. clearly demonstrate this scenario.

4.6 THE ROLE PLAYED BY ADMINISTRATION

As per the student's viewpoint, follow-up actions on the reasonable requests of students are not taken promptly by the administration. According to them such matters are discussed in meetings repetitively with no significant progress for months leading to frustrations. The delays made in following the university protocols and procedures related to purchasing of equipment/accessories, obtaining services, building construction…etc is a major factor which increases the frustration of students regarding the administration even if some of such delays are beyond the control of the administration. The attitude problem of most of staff members/administrative officers was raised as another issue behind this scenario. Above frustrations of students provide opportunity for the raggers to further establish their justifications against the administration to attract followers from junior batches.

Students on the other hand highlighted that certain important evidences handed over to the administration related to ragging incidents/harassments have not been investigated properly and action taken. Consequently, the seniors have established the notion that there is no point in complaining regarding ragging/harassments to the administration as no action will be taken. Accordingly, the students who attempt in eradicating ragging/harassments are demotivated/ demoralized while the raggers/harassers are motivated and empowered under the impression that the top administration is with them.

4.7 RAGGING AS A MEANS OF FULFILLING SEXUAL DESIRES

Treating differently due to gender, gazing, stalking, name calling and joking in sexual ways and making violent statements using sex associated filthy language were identified as part of ragging highlighting its purpose as a means of fulfilling sex related desires of male students. In some of the degree programmes each fresher is called by a name (card) given by the seniors after testing their eligibility during progress meetings. These names given to the male students are much of sexual nature (obscene/filthy words related to sex organs, obscene sexual acts, sex related defects…etc) having a background story/song depicting obscene sexual acts. While byhearting the names of all the batchmates the freshers are forced to perform the said degrading sexual acts (allied to the card) in front of others.

5. Concluding remarks on remedial actions

The UOX community who have been blinded by the misleading, faulty myths of raggers could be directed towards a hope of light by reflecting on the revelations of this study. In the process of eradicating ragging from the UOX, it would be essential for all the members of the administrative and

academic staff to be unanimously maintaining one voice consistently against ragging. On the other hand, the staff should use a friendly, sensitive, supportive, trustworthy and ethical approach in dealing with the students ensuring their availability for students in academic, personal, financial as well as any other issue. While coming up with innovative programs to transfer correct information to the newcomers beforehand, strategic actions should also be taken to empower their self-esteem, personality, soft skills and leadership skills. Actions should be taken to identify students with psychological imbalances and thereby prone to ragging mentality and to assist them with counselling and therapy as necessary. It is essential to remove the long-established respect/authority seeking structural dependency on seniors whose underlying agenda is ragging/harassment. In doing so, innovative strategies/programmes should be adopted to nourish the notion that the respect and seniority have to be earned through a humanistic and sincere approach by setting good examples; helping with academic activities and language issues, finding boarding places, finding training places…etc without any hidden agendas but purely on brotherhood, sisterhood and humanity.

A holistic, strategic, innovative and proactive approach is needed to gradually break the well-established deep-rooted bonds in the interconnected network of raggers between the diverse layers; schools, tuition classes, academic levels, alumni, student union and the political parties, carefully considering the roles of each and every layer.

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COMMERCIAL EVOLUTION OF WATERFRONT: A HISTORICAL ANALYSIS OF LAND USE PATTERN & TREND OF COMMERCIAL CENTERS IN KHULNA RESPECTING BAROBAZAR, KHULNA

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Abstract
Although Khulna's actual history is not about more than 200 years, but it has a 2000 years settlement and commercial history. Khulna was a part of Ganaridai, Vanga, Jessore dynasty, Rarh (South Bengal) in different periods. The connection of rivers always made a blessing for Khulna for water transportation to accelerate trade and commerce. According to Ptolemy, the ancient Gangaridai had an ancient port located in greater Jessore [1,557]. Some archaic incidents, verses, and legends of Mani-Rishis (Ancient Indian Scholars) proved the old settlement and commercial style. The chronological evolution of the ancient Period (6th century BC – 1757 AD) described a civilization's development with the incremental commercial approach [2,315]. The colonial regime can relate to the evolution of a commercial and economic center like Barobazar as a whole. All these chronological narrations, consecutive phenomena, and influential factors will depict the trend of retail evolution. The research aims to describe Khulna's commercial development's sequential affairs and find the missing links between eras. Various ancient documents, Blueprints, Greek Periplus, etc. will describe the settlement, commercial mode, and history. It will determine the answer to the questions about the growth and establishment of river port cities and major economic centers' evolution. The paper will describe commercial –spatial progression in 4 Particular eras. GIS surveys and some old maps will illustrate the commercial land-use patterns of Barobazar from the Colonial Period to the present and the river base trade. These will elaborate on the existing conditions as well as the revolutionary changes. The fundamental research will help for the further Urban regeneration of Barobazar as a central economic hub. The historical consequences will help to sort out the development pattern and strategies behind the progression.

Keywords: *Commercial Evolution; Historical Chronology; Trend in Commercial Development; Economic Major Hub; Commercial Land Use.*

1. Introduction:

The Khulna is the third-largest metropolitan city in Bangladesh, with 1.2 million populations within 45.6 square kilometers (Ahsan 2012). It is a city of riverports (ghats), and it is also served by the second-largest seaport (Mongla) in Bangladesh. Historically Khulna was a part of Vanga or Samatata, Sultanate of Bengal, Baro Bhuyans & Mughal Emperor. During the Colonial Period, firstly, it was under the rule of autonomous nawabs (rulers) of Bengal until 1793, when the British East India Company abolished Nizamat (local government) and took control of the city. [3] Though there is no reliable information on the trade of Khulna during the Mughal Period. There are some documents about the salt trade, but it cannot tell the whole scenario. River Bhairab was a lifeline for water transportation owing to trade and commerce for the ancient Period. Due to the fertile land upon the shore of river Bhairab different settlements have also developed, and many antique markets also evolved in its continuity. During the colonial regime, a massive transformation in trade happened due to different influential factors such as river ports, the Creation of Rupsa, New communication development.[2,985]. These phenomena influenced waterfront base economic and commercial growth respecting Barobazar during the Colonial Period. (Ahsan,2012). Later, due to the rapid development of communication and infrastructural transformation, Barobazar is the major economic hub in the southern part of Bangladesh. As the rapid urbanization has taken place at Barobazar due to different influential factors and multiple actors at independent Bangladesh, rapid commercial land use pattern changes are the reason. This research will critically analyze the historical evolution and multiple factors regarding the commercial state of Khulna and the changes in land-use patterns, and the current trend of Barobazar. We will explore the Spatio-temporal prominence of the land use pattern in 4 distinctive sections- Early Colonial Period, Colonial Period, Pakistan Period & Independent Bangladesh period. The socio-political scenarios of the early '80s have created an influential-changes in the demography and physical environment of Barobazar.

2. Early Colonial Period: 6th-century bc to 1757:

Evidence of the first settlement in Khulna is found in the early Hindu Period. Some of its descriptions are known from ancient verses and the legend of Mani Rishi. We do not know much about Anaryans (Pond, Chandal, Bagdi) as they had no specific religion and food habit. However, the first Aryan settlement has happened in 6th century BC via water transportation. Among Aryans castes, first Kshatriya (Warrior) Aryans invaded the "Vanga" (Bongo), then Vaishyas (Businessmen) came here for business purposes. Brahmins come at the end of all to preach the religion. Moreover, there also established some pilgrimage in Ancient Khulna. The south part of Bengal was considered a part of ancient Vanga, and the subdivision was called Rarh. [2.327]

A. Commercial state and trend in Ancient Khulna: We heard about the large boats on the rivers as a medium of large water transportation by Indo for the Aryans. Nevertheless, actual commercial state-run after the Aryan Vaishyas had come here in Vanga, they introduced internal trade within the Indian Subcontinent considering Vanga. Before that Anaryans water transportation medium was a small boat called "Bachari", we heard about the salt business from the sea surrounded Sundarbans. Salt factories (Vand) were called "Molonga," and salt producer was called "Molongi". This salt business ware progressed by Aryans. The transported salt from Sundarbans to other states via the river network.[2,329]

B. Ganga Ridai and the Oldest Port: According to Greek ambassador Megasthinis (who was at Morya Chandra Gupta's Rajsava), Jessore and Khulna were called Ganga Rashtro or Ganga Ridai or Ganga Radi. Gangey / Gangarejia is considered one of the principals and oldest commercial port of the Indian Subcontinent (located at the old Jessore, Not current one, according to Pareshnath Banarji). Greek "Periplus of the Erythrean Sea." The first possible international trade had been heard in this Period. The river channel of the lower Ganges influenced Gangarejia. The port was famous for exporting Maslin, Coral overseas.(The southern part of Calcutta towards the sea was familiar as a coral island for the abundance of coral). [2,327-328]

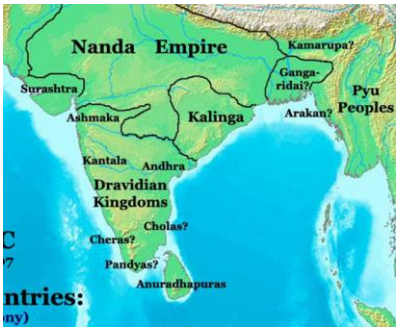


Fig. 01:East Hemisphere, Map of Ganga Ridai -323 bc [4]

C. Shena Dynasty (1200AD): In ancient Khulna, Sundarban was familiar as "Dwiganga." Due to Sundarbans' ups and downs, Shenas came to Barishal and Khulna area and established at RayerKanthi and Bangram. They had established some settlements within the bank of river Bhairab. Shener Bazar at Aichgati, Belfulia is considered as an ancient market established in Shena dynasty. It is believed that several local haats (village market) had been established in that Period within the riverport support and water transportation system.[2,355]

D. Muslim Period(1301 AD-1793AD): The first Muslim arrived at ancient Khulna in the 12th or 13th century AD. In 1301 Khulna came under the independent Muslim Sultanate of Gauda. Later, Khan Jahan Ali, Hussain Shahi, Pathans, Vikramaditya, Pratapaditya took the control. Vikramaditya was defeated by Man Singh I, a Hindu general of the Mughal emperor Akbar, in 1611. [2, 751]
Commercial state of Bengal Sultanate: According to Irfan Habib (2011), Ma Huan's testimony described the shipbuilding Industry in the Bengal sultanate. Co-existed Bengali ships with Chinese in

the Mid-15th century in the Indian Ocean, according to the testimony of European travellers, also supported that.

Influential Commercial Trend in Khulna Regarding Sultanate:
According to Satish Chandra Mitra, Khulna had a trend for commercial Boat factories (Because of the adequate supply of wood from Sundarbans). The sea surrounded Sundarbans had enough possibilities for an establishing port like Gangey in the ancient Khulna. Even though the Salt business was continuing in Nawabis and also in Sultanate. Bhairab had a history of commercial water transportation also. Some ancient markets besides the Bhairab river bank also run in that Period. Khulna, specially Sundarban, may have a commercial trade relationship with overseas like Maldives and China (Wang,2017). Among all exported ingredients, Muslin, Rice, coral & Coconut had exported from the south Bengal. (Sushil Chaudhury,2012) Above all, in ancient Khulna, the maritime trade, the rivers' connection, and the abundance of exportable goods encouraged the Company to establish a trading center later in the colonial era.[2,442,483,493]

Socio Economical Dark Era: Mugs & Firingis: The Portuguese (Firingis) started coming to South Bengal for trade in the first half of the 18th century. Despite their exclusive rights to the Sundarbans salt trade, they are involved in human trafficking. Later in 18s, Shaista Khan expelled the Mugs and Firingis from the south. So, these fifty years is considered a black chapter in the southern region's trade. [2,627]

The settlement & the commercial trend at the riverbank of Bhairab from the ancient era to Autonomous Nawab: Due to the rise and fall of the Sundarbans, the Sen dynasty of Gangarejia moved upwards and settled on the banks of the Bhairab. The land upstream of the river helps them to expand their agriculture. Sen's market at Aichgati in Belfulia is considered to be of that era. Besides, it is known that many more hats and bazaars were established on the banks of Bhairab. Agricultural products were significant in the commercial field. Cotton and paddy cultivation are especially known. Bhairab bank had become a commercial center and river port later. The commercial style of ancient Belfulia is seen as one reason for the development of the Barobazar on the other side of the river.[2,394-396]

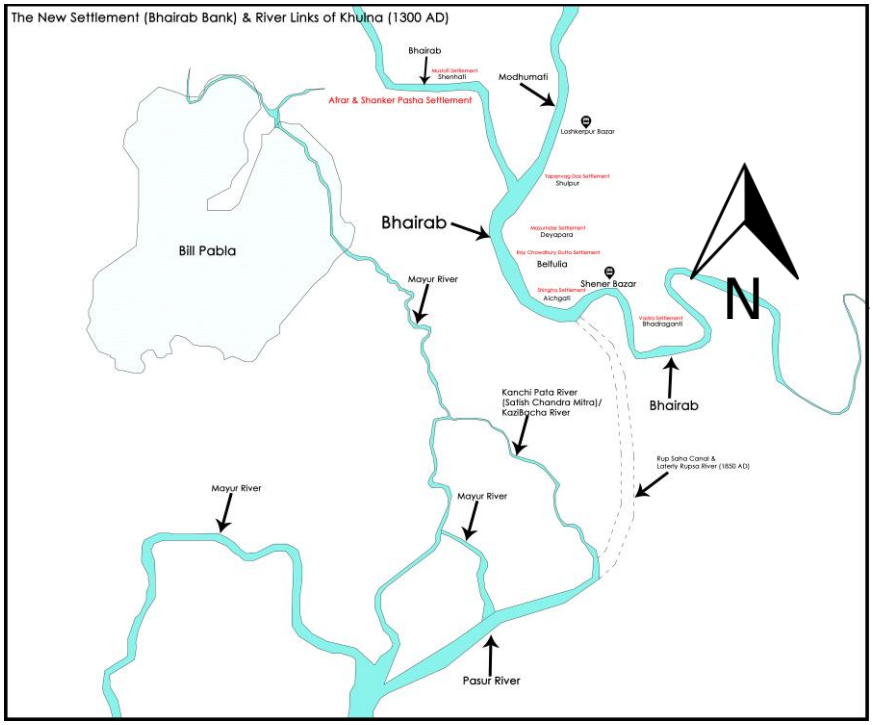


Fig. 02: The settlement map at Bhairab bank according to “Satish Chandra Mitra”, Source: Author [2,394-396]

Socio – Economical Chronology & Influential Factors for the commercial trend in Ancient Khulna

According to Satishchandra Mitra, the ancient Khulna was a part of Sundarbans. The whole settlement had established by creating new lands by clearing forests.

Timeline	Socio-Economic Incident	Influential Factor
6th Century BC	Indo Aryan's River Trade through Bhairab-Pasur	Salt Trade
1st Century AD	Port Gangarezia, Trade with Overseas	Boat Building and River & Sea Transportation
13th Century AD	Settlement on Bhairab Bank	Ups & Downs of Sundarbans
15th Century AD	Salt and Agricultural Product Trade, Higher GDP	River Bhairab and Pasur
17th Century AD	Dark Era in Economy	Mugs & Firingis

Fig. 03: Socio-Economical chronology of ancient Khulna [2]

3. Colonial Regime: Emergence of A new Commercial Center, From Charlie's haat to Barobazar (1757AD-1947AD)

Indigo Planting & Charlie's Haat :

Khulna came under the Company in 1793, when Nizamat was abolished.[3] After coming into the hands of the Company, the East India Company began to see Khulna as a potential field for trade. The British started cultivating cotton, indigo, and sugar.

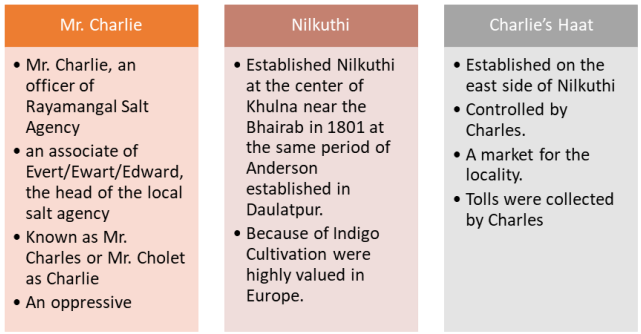


Fig. 04: Evolution of Charlie's Haat [12]

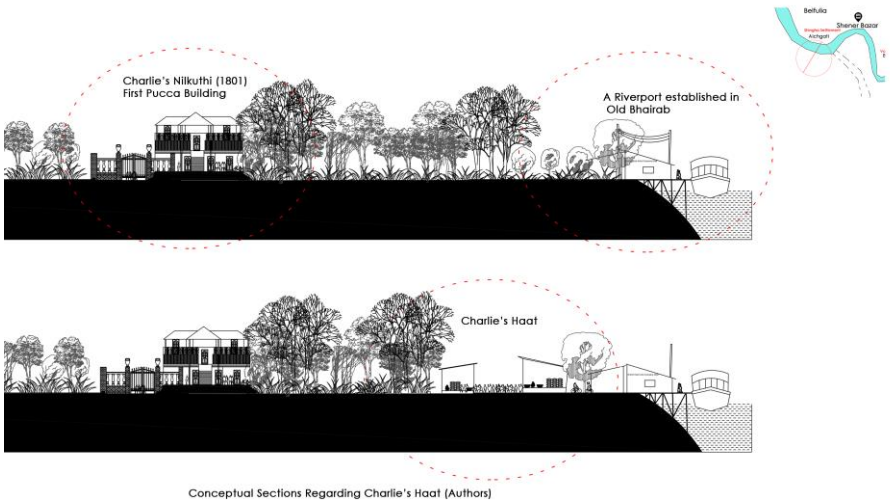


Fig. 05:Conceptual Sections Regarding Charlie's Haat, Source: Author

Geographical & Demographical reason behind establishing the Haat and Nilkuthi: The geographical reason behind the establishment of Nilkuthi was the bend of the old Bhairab river towards Alaipur. At the edge of which was the ancient settlement of Belfulia. The settlement of Belfulia from all other regions, especially Aichgati (on the other side of the Nilkuthi), was significant. Sen's market at Aichgati was one of the oldest markets.[2,394] Some historian thinks that Mr. Charlie of salt agency and the Chollet saheb of the haat was not the same person. Indigo Cultivation was started in Khulna after a decade of establishing Salt Agency (last Quarter of the 18th century).[12,462]

Time Line	Influential Incident	Factors
1766	Ship Falmouth sank in the Pashur River	Culnea /Khulna was first described in the ship's documentation
1781	'Nayabad Thana' Established	
1781	Rayamangal Agency, established	Salt Trade via Bhairab - Pasur
1791	Clash between William Renee an Indigo planter and Zaminder Shivnath Ghosh	The riot of Nilkar vs. Praja
1836	a police station named Nayabad was established at Talimpur	Rayamangal Salt Chowki of Koylaghata taken the responsibility
1842	Kismat Khulna , Khulna Subdivision established	First subdivision of Bengal, established to control Clashes

Fig. 06:Influential Factors chronology During British East India Company [2,21]

Historical Influential factors Behind the Commercial State of Khulna: Rayamangal Salt Agency was mentioned that Khulna was once famous for its salt traders. Salt was cultivated in the estuaries of the rivers along the coast. Salt laden boats crowded the shores of Bhairab. However, it was challenging to cross the river and come to the Bhairab river; it took much time. Rupchand Saha, a salt trader, saw that if the canal were cut three miles from the Kazibachha river's mouth to the bend of Bhairab (now the jail ghat), the problem would no longer exist. The name is Roop Saha Khal. Later, the Bhairab stream turned that narrow Saha canal into the Rupsha River.[2,21]

Factors Behind Evolution of Shaheber Haat as Commercial Hub for the Khulna:

I. Influential Communication System: Four decades after creating the subdivision in 1842, Khulna was turned into a district in 1882. By the 1880s, the Rupsa River (Rup Saha Canal, 1850) created & established connectivity with the Calcutta. The place had a commercial influence because of agricultural products like cotton, sugar, and later indigo. For this reason, river transportation via boat, as the ancient Khulna introduced. Charlie's haat had renowned as a river port then. [2,21] For this kind of advantage, British Raj was looking for a more significant commercial arrangement. For better navigation before the two years of establishing Khulna as a district, in 1882 introduced Steamer Service. This service was run by the famous "Bengal Central Floatila Company." The steamer ghat was near Charlie's haat / Shaheb's haat called Delta Ghat (Currently a broken Ghat using as godown). Steamer services were running in the route of Khulna – Barishal – Dhacca, and also Khulna-Calcutta. After four years, In the year 1884, the Rail Service had activated. The total length of the rail line was about 110 miles from Khulna to Calcutta. It took 4 hrs to reach. The steamer service for Barishal and Dhaka was linked to this train service. Like, if the train at 9 pm came, then the streamer started. The activation of train services made a groundbreaking change in trade and commerce. In 1918 the Rupsa-Bagerhat Rail-Line had activated. A steamer called Dak Steamer used to travel from Delta Ghat to Rupsa. From a long time ago, Jessore road had connected with Khulna via Fultala, Fulbarigate, BL College, Goyalkhali, and 1 no. Customs Ghat. It was narrow and zigzagged. After establishing the rail, it had extended from Clay road to Joragate. An optional road also had been created at the south of the railway property. This had connected Dak Bangla with Joragate. [2,25]

II. Arrival of New Traders and the evolution of a larger business center: After the steamer and rail service activation, Charlie's haat turned into a large business center. New people in business, merchants, and traders started to come here from home and abroad. Marwari traders come from Kolkata and adjoining areas. They came to the center of the market and started trading by setting up shops, warehouses, god owns. Attempts are being made to reshape the old and unplanned haat by constructing planned roads to make them suitable for the district town. Gradually, the region became the major commercial and economic center. The old haat become the biggest market in the town, why people started to call it Barobazar means the big market. [12,118]

Evolution in stakeholders, structures of the market place, and land use pattern in the Colonial Period: The evolution of stakeholders, structures of the market place and land use pattern were divided into two phases in the Colonial Period. The phases had created for the power shifts between the British East India Company and British Raj. Another Influential Factor was the river Rupsa which enabled water transportation and made British Raj thinking for a new trade revolution.

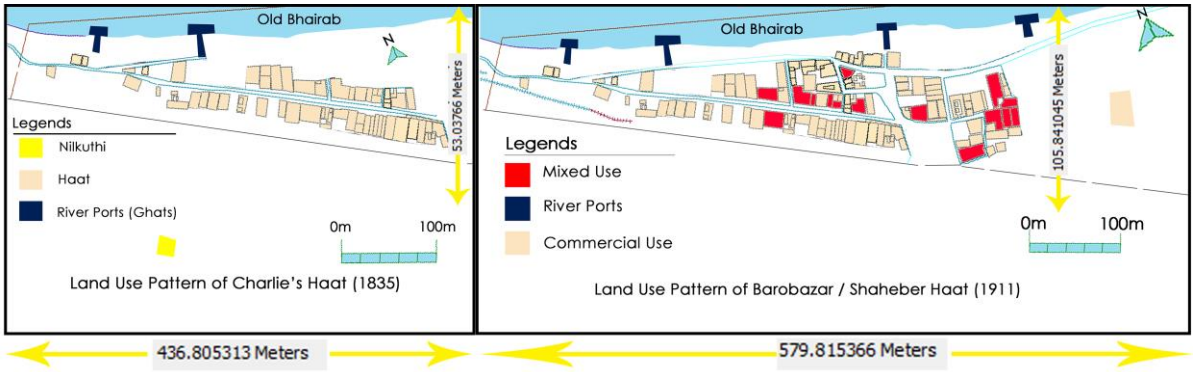


Fig. 07: Changes in Land Use Pattern Between two phases (British East India Company and British Raj), Source: Author

Comparative Analysis of Evolution		
Timeline	1793-1858 (Company Period)	1858-1947 (British Raj Period)
Stakeholders	East India Company, Raymangal Salt Agency, Local People	British Raj, Marwari & Hindus from Calcutta, Local People, Khulna Municipality, BCR, Assam- Bango Railway, Bengal Central Flotila Company, Local Zaminder (Zaminder of Jessore)
Commercial Style	Local Market, adjustment with Nilkuthi	Economical Center, Biggest Market in the city, Regional trade center
Structures	Most of provisional structures, except Nilkuthi	Pucca Structures, Provisional Structures
Land Use Pattern	Commercial	Commercial and Mixed use, Community structures
Tax Receiever	The chief of Nilkuthi (Charlie)	Local Zaminder
Transportation	Boats and River port Services (2 Ghats)	Steamer Services, Rail, Roadway, River port and Steamer port

Fig. 08:Comparative Analysis of Evolution in Colonial Period [12,462]

Trade policies According to Chronology:

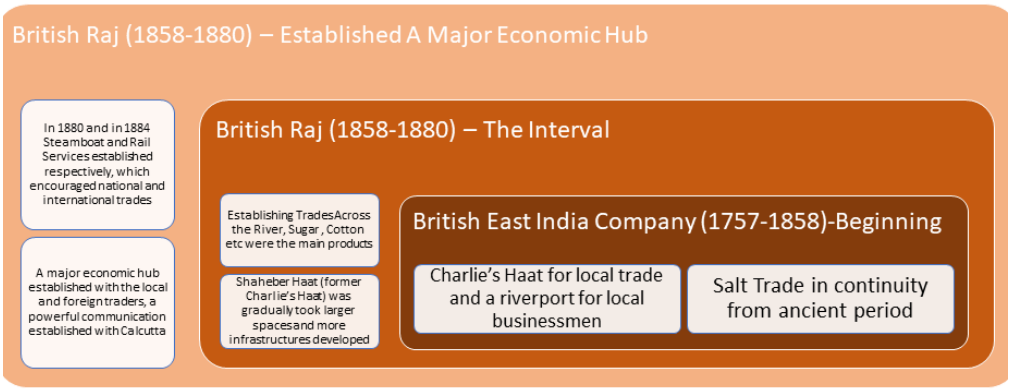


Fig. 09: Trade Policies in colonial regime [2,985]

4. A massive changes in Owners and Evolution of a new Commercial Trend in Pakistan Period (1947-1971):

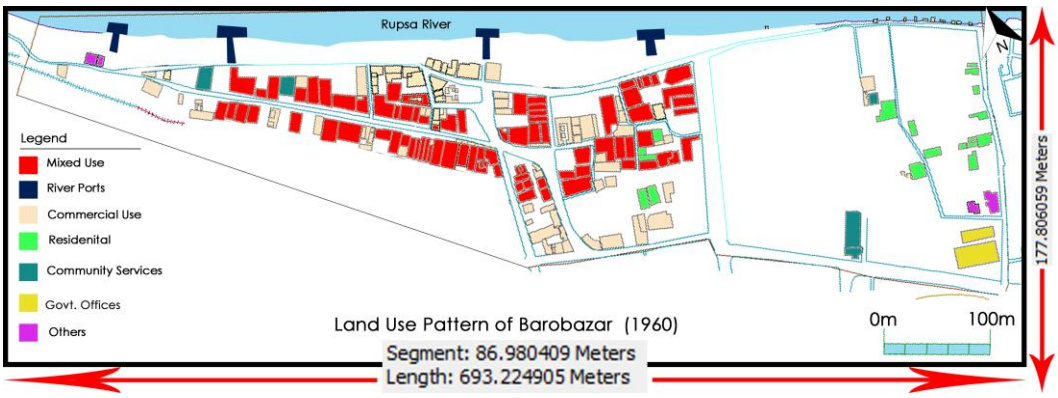


Fig. 10:Infrastructural Map of Economic center of Barobazar in Pakistan Period, Source: Author

During the 1950s to 1970s, the trade multiplication effect of rapid industrialization in the Khulna region transformed the social, economic, and urban fabric of Khulna city more like an industrial base than a commercial. (Ahsan,2012) After the division in 1947, Khulna included with the Pakistan partition. Why the rail connection and road connection with Calcutta had shut down. So, most of Hindu and Marowari owner left the country as well; they left the property. East Pakistan had established a new and well communication with East Pakistan. Most of the Punjabi & Islamia community came here for business purpose. They took over the shops and trades left by the Marwaris and the Hindus. After 1947 as a new force called EPR (East Pakistan Rifles) was established, the property started to use as EPR colony. Those were thatched huts. The main marketplace almost remained the same as it was in Colonial Regime. Many mosques were also established there. They extended a little portion of the market. The steamboat service also had activated in that Period with delta ghat. In 1964 KDA (Khulna development Authority) established and influenced the rapid urbanization, which played an important role for Barobazar and Dakbangla to be an economic zone and city center. In 1960, Jessore Road was straightened in a new way. As a result, it merges directly with Dakbangla. This further accelerated business communication.[13,162] Although the Bazar portion was almost the same, a new commercial zone and mixed-use zone were also developed. Some official buildings, banks, residential hotels, and residential infrastructure development in the southeast portion of the main market. Some secondary roads also had developed in this Period for communication purposes. The whole development pattern encouraged Barobazar as the central economic zone and the city center. These commercial developments between the 1950s and 1970s influenced Barobazar to be the southern region's major economic hub in the late 90s. After the 1950s,

according to the Land Rights Act, the market is auctioned off and leased. These tenants used to collect money as they wished. This system has been changed after the liberation war. [12,462]

5. Bangladesh Period (1971-till today) :

Ownership Map Of Barobazar & KalibariGhat Zone

[Source: Investigating Socio-Spatial Dynamics of Encroaching Urban Waterfront: A case of Boro Bazar along Rupsa-Vairab River-Belt, Khulna , Partial Requirements of MSc in Human Settlement Thesis by Mahmudul Hasan Bhuiyan , Khulna University]

Fig. 11: Source: Mahmudul Hasan Bhuiyan (2018)[15]

After the liberation war, the commercial sail of the Barobazar took a new breath. As the importance of Khulna as a district town and a major commercial city increased, so did the expansion and importance of the Barobazar. The changing city form gave Boro Bazaar the shape of a mixed-use zone rather than solely a commercial or business zone. The international highway between India and Bangladesh, the divisional highways, railways, and inter-district waterways crossing over Boro Bazaar and their trade links makes it highly potential and important for national and international trade and commerce. (Ahsan,2012). In the after-liberation war period, most Pakistani people went to their country by selling their business to the local people. Thus how after 71, the local people gradually took part in commercial and industrial trade. A lot of small cottage industries developed in this Period. A rapid transformation happened to create a new trade class division. Besides, a nationalist political influence in 80s, created definite trade policies and classes. The socio-political scenario also impacted the economy. In 1984 Khulna achieved the rank of a divisional city as well as Khulna City Corporation Established. A new wholesale and retail market (Khwaja Khan Jahan Ali Hawkers' Market) was also had established. In 1985, because of the construction of the new station road and infrastructural development. Some godowns and mills had shifted to the railway property, which was previously EPR Colony. Several oil and masala mills, godowns, Wholesale shops, goldsmith shops, and residential development occurred across the vacant lands. New official Buildings developed across the Sir Iqbal road from Thanar Mor to Kalibari Ghat. As the existence of the dam protecting the city is almost disappearing, from the last 50 years, temporary structures built at the bank of Rupsa. Which are using for wholesale and retail shops, wholesale shops, and godowns. In 1972, a committee was formed under the supervision of the Hat Bazar by an order called Hat-Bazar system to remove the problems related to the lessee. Toll was collected through a youth cooperative. However, due to land ownership by various institutions such as Railway Corporation, BIWTA, City Corporation, and private ownership, tolls are collected in different ways. For example, the city corporation collects revenue from the railways on the land owned by the railways. Individually owned property is leased individually, and many disputed properties are still in the DC office and privately owned inter-conflict. [12,462]

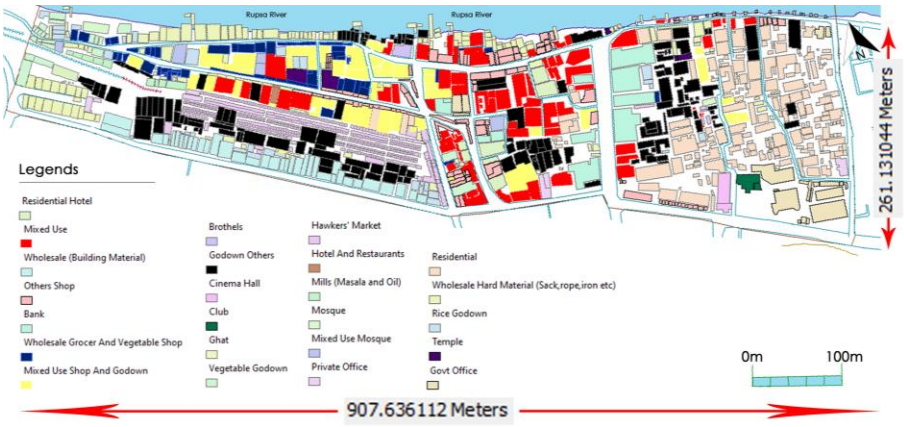
The Existing Land Use Pattern of Borobazar in 2020:

As the population of Khulna increased, so the density of Barobazar also increased tremendously. In the current situation, Barobazar stood in a condition where there is no vacant land and faced an unplanned development, which creates a massive haphazard situation in Market Place. Though the southern part of Barobazar is a little bit messy but over-all, it faces so many problems in spatial management. Here we have surveyed the whole Barobazar marketplace, market places from clay road, and official areas at sir Iqbal road to the later developed residential zone at the south. This will give a

clear idea regarding the development pattern of a mixed-use zone from the commercial zone and an economic hub's development, the existing condition created from rapid urbanization, which was influenced by Barobazar. Moreover, finally, this survey will direct to the policies of Urban Regeneration.

Fig. 12:Study Area: Barobazar & Kalibari Ghat Zone,
Source: Google Earth Pro

Land-Use Pattern: Although there is a high financial flow in Barobazar due to multiple actor encroachment, rapid urbanization, Political influences made Barobazar a zero vacant land zone. The structural density is so high that there has occurred a different kind of land tenure. Some have been possible due to land grabbing, the river-belt possession. Hawkers' grabbed the footpath and also the cover drain . The occupancy map of 2020 depicts the haphazard situation of Barobazar as well Kalibari Ghat zone.



Name	Number	Area	Percentages
Commercial	530*	56675.75	52.91%
Industrial	9	650.38	.61%
Mixed Use	210	20484.26	19.13%
Community Services	13	2315.5	2.16%
Residential	179	13692.3	12.78%
Govt. Service	9	3105.77	2.9%
Non Govt Services	8	791.75	.74%
Roads		5297.703	4.95%
Open Space		4092.38	3.82%
Total	958	107105.8	100%

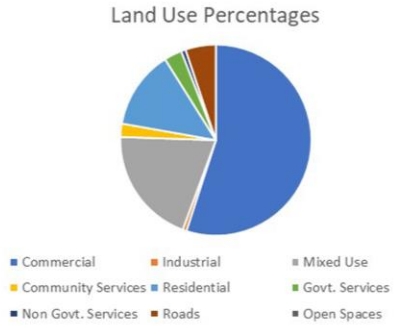
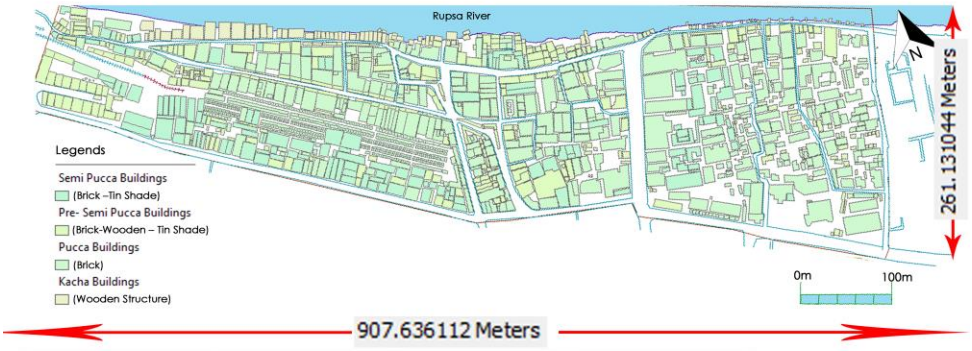


Fig. 13:Occupancy Map of Barobazar & Kalibari Ghat Zone, 2020, Source: Author

Infrastructural Condition:
In recent years, a massive number of Pucca buildings has developed due to economic expansion. But due to the breach of the city protection dam, a lot of temporary structures also have been developed in the last 4/6 decades.



Name	Number	Area	Percentages
Semi Pucca Buildings (Brick –Tin Shade)	59	24506.74	24.70%
Pre- Semi Pucca Buildings (Brick-Wooden – Tin Shade)	451	19429.61	19.58%
Pucca Buildings (Brick)	434	51809.51	52.23%
Kacha Buildings (Wooden Structure)	271	3456.68	3.49%

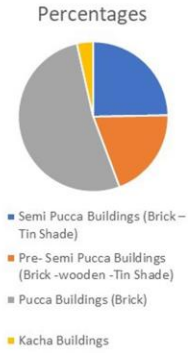


Fig. 14:Structural Map of Barobazar & Kalibari Ghat Zone, 2020,Source:Author

Existing Commercial Condition In 2020:
Barobazar has already developed its infrastructure in an unplanned state, not just in an unplanned economic expansion. Needless to say, as the number of small cottage industries and mills has increased in the last 15 years, so has the amount of vacant space. However, due to the sharp decline in such economic activities, it cannot be said that the standard of living is going down. Land grabbing, the prospect of higher profit jumps, and disputed property are hindering new thinking about the big market's development pattern. The occupation of the banks of the Rupsa river, the temporary shops, and the sidewalks' occupation by hawkers all indicate this.

The Flow of Commercial Evolution Establishing the Missing Link Between Eras:

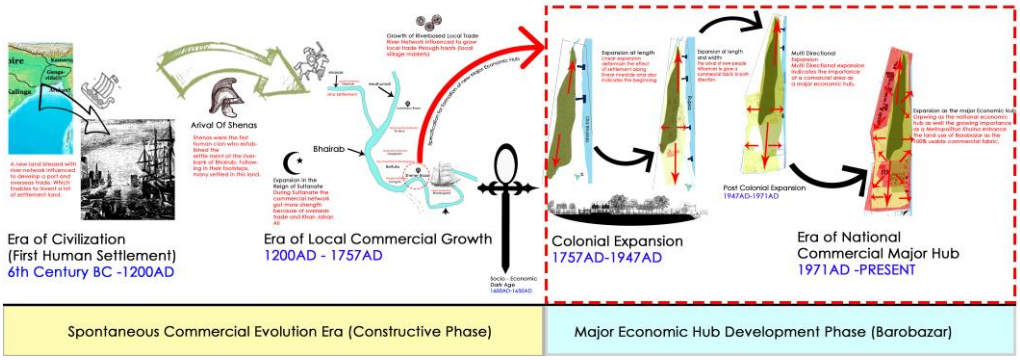


Fig. 15: Chronological Flow of Commerial Evolution,Source:Author

6. Research Opportunities:

As the center of the heart of Khulna city, Barobazar has developed in a spontaneous and unplanned way. There were so many missing links to its evolution and growth. Many data were not available on why the revitalization and proper development of Barobazar was a myth. This paper tried to enhance that opportunity for further research about Barobazar in the near future.

7. Conclusion:

Whether it is geographical or political, the Khulna region's economic importance and backbone have been built since ancient times, although scattered trade activities have been going on since ancient times or there was an expansion of local trade for local settlements; nevertheless, it must be said that Khulna was so vital that it was behind this ancient trade. This is because Bhairab has been navigating since the expansion of the salt trade in ancient times. As a result, the Rayamangal Salt Agency started its journey in the Colonial Period. As a result, the construction of a river port on the banks of the Bhairab, the digging of the canal by the salt merchant Rup Saha and the establishment of Charlie's Hat are all part of this. In the end, its commercial evolution is responsible for the emergence of today's Barobazar as the largest marketplace in the southwestern part of Bangladesh, or as a central economic hub. Everything has expanded, the economy has recovered, new institutions have sprung up, but at the end of Barobazar's thousand-year history, today's commercial land use pattern is deplorable. The trend analysis of the last century tells us the cause of this condition. This research of evolution and trend will play an essential role in the revitalization and regeneration of Barobazar and will guide future research regarding Barobazar.

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IMPACT OF POOR QUANTITY SURVEYING PRACTICES ON SMALL SCALE CONTRACTORS IN SRI LANKA

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Abstract
Construction industry is one of the devoting force of any country's economy. Around the world, Small Scale Contractors (SSC) has been found to play a significant role in creating jobs, infiltrating new markets and growing the economy in an inspired and inventive way. However, performance of SSCs in developing and minor developed countries is still not in adequate level due to various factors. Poor QS practices is one of the significant factor which affect to the current performance of the SSCs. Hence, this research aims to implement better QS practices to mitigate adverse impact to the small scale contractors due to plenty of poor QS practices. Particularly qualitative research approach was used for this study and accordingly data was collected from semi- structured interviews and analyzed using manual content analysis. Project delays, cost overruns of projects, cash flow problems, unable to win tenders, poor construction quality, delays in payments and contractual disputes were identified as major issues caused by the poor QS practices. This research suggests government to impose laws and regulations, offer tax relieves to contractors and impose legal requirements to participate in CPD sessions to minimize poor QS practices. Further clients and consultants can make timely payments to contractors and key suggestions to contractors are hire experienced and qualified professionals, provide well-coordinated training, adopt new technologies, keep clear and completed drawings and specifications, use cost and time controlling techniques and maintain good record keeping system.

Keywords: *Construction Industry, Small-Scale Contractors, Poor Quantity Surveying Practices*

1. Introduction

The construction industry is widely regarded as unique and distinguish from other economic sectors (Olatunji, Sher, & Gu, 2010). Construction industry is still critical in the socio-economic development aspects of each and every country (Callistus, Felix, Ernest, Stephen, & Andrew, 2014). According to the Central Bank Report 2018, demand for the construction industry increases continuously due to the population growth and economic growth in Sri Lanka. Amoah, Ahadzie, & Danso (2007) pointed out that financial status, experience, plant and equipment and personal qualifications are taken into account when registering as a contractor and classify them as small, medium or large scale contractors. Author further elaborated more than 90% of construction companies in every country are small contractors. In developing countries, Small and Medium Enterprises (SMEs) are one of the significant components in the construction economy and create extensive job opportunities (Dlungwana & Rwelamila, 2000). Small-scale contractor is often seen as a "one-man enterprise with a low budgetary, investment base and having lack of management skills to address the many problematic challenges they continue to function in the industry" (Amoah et al., 2007).

Although small and medium enterprises contribute to the economy, they face obstacles that hinder their development (Mahembe, 2011). According to Handayani (2017), SSCs only consider about short-term profits and they do not need a strategic plan to make profits. Further author highlighted project completion delays, over budgeting, misuse of resources, poor construction quality and construction waste are the most challenging issues for SSCs. Additionally, Bartlett and Bukvic (2016) emphasized challenges of SSCs includes shortcomings in marketing, inadequate management skills, constraints on business skills, lack of human resources, high capital costs and inefficiency. Handayani (2017) further particularized that SSCs have to face huge constraints to develop their competence, service and gain advantage and contactors must improve their performance to survive the industry. QSs are professionals who direct clients on the budgetary and design decisions on implications of value and the monitoring construction costs (Ashworth, Hogg, & Higgs, 2013). To perform the project cost, financial control and contract management at each stage from inception to completion are important tasks of a quantity surveyor (Nagalingam, Jayasena, & Ranadewa, 2013). According Thwala & Phaladi (2009), poor record keeping, poor pricing, poor tendering, lack of contract documentation skills, poor

methods of preparation of interim payment applications, lack of knowledge on claims and variations are the most common QS related issues of the SSCs.

Even though previous researches have covered the different angles on issues of small-scale contractors in both international context (Thwala & Phaladi, 2009) and in Sri Lankan context, significant impact of poor quantity surveying performances on small scale contractors has not been discovered yet. Therefore, this research focused to implement better quantity surveying practices to mitigate adverse impact on small scale contractors due to poor QS practices by determining current quantity surveying practices of SSCs, issues faced by the small-scale contractors due to poor QS practices and by proposing strategies to overcome above issues.

2. Literature Synthesis

Construction industry helps for society to accomplish urban and rural development goals (Enshassi, Al-hallaq, & Mohamed, 2006). Construction industry is critical in the socio-economic development of each and every country (Callistus et al., 2014). Through the links of construction industry with other industries, it performs huge role in the economies of every country, thereby reducing unemployment and spread of national wealth (Asante, Kissi, & Badu, 2018). Yogeshwaran, Perera, and Perera (2014) believed that the significant features of the construction industry are: large scale, scattered compared to other industries, high labour intensity, cyclical variations, encouragement of the government as a main client, tailor-made products and using technologies. Such characteristics make the industry as an engine of economic development (Horta, Camanho, Johnes, & Johnes, 2012). In order to maintain economic development while the economy is booming, the function of the construction industry becomes crucial when further infrastructure and facilities are needed (Majdalani, Ajam, & Mezher, 2006). Sri Lankan construction industry contributed 9.3% of GDP in 2017 compared with 2016 and it implied the local construction industry is booming (Economic and social statistics of Sri Lanka, 2018).

Contractor is an individual or organization that commits to carrying out a construction project in compliance with contract documents on behalf of the client (Rameezdeen R., 2006). In Sri Lanka there are more than 2500 number of contractor organizations registered under CIDA. Depending on the specialty in field, building contractors are classified according to the CIDA grading scheme and further they were classified into 11 categories based on the type of the product. However CIDA classification does not categorize contractors as small, medium or large scale contractors. Hence for the purpose of the particular research C5-C9 contractors are considered as SSCs.

2.1 SMALL SCALE CONTRACTORS

The definitions for SSCs are varying from country to country because of the status of economic development (Eyiah, 2004). However, the most common definition for SSCs can be broadly explained as “a construction firm imperfect with initial investment, plant and equipment, and resource constraints, because some support is required to survive in the industry” (Callistus et al., 2014). Usually, a small number of large-scale contractors and a large number of small-scale contractors are involved all around the construction industry in the world (Ashworth et al., 2013). SSCs can be a powerful tool for job creation because SSCs can execute small projects in different remote areas which may not be attractive to large companies due to too expensive, low management costs for SSCs and SSCs can work at more competitive prices. SSCs can assist to expand the construction industry conquered by reputable large scale contractors due to easy entrance with relatively lower skills and resource scale (Thawala & Mvubu, 2008). Most of the registered contractors in Sri Lankan construction industry belongs to the SME category (Balachandra, 2014). Sri Lankan SMEs perform a significant role in the economy by providing employment opportunities like large scale construction firms. However Ranadewa, Sandanayake, & Siriwardena (2015) pointed out that, in Sri Lanka SMEs have been identified as important strategic sectors for economic growth and social development of the country.

2.2 IMPORTANCE OF SMALL SCALE CONTRACTOR

SSCs in developing countries help to generate jobs, contribute to national development, elimination of poverty and the catalyst for economic development (Mohammed & Obeleagu, 2013). According to the Thwala and Phaladi (2009), and Eyiah (2004), there are some importance of SSCs as follows.

- Need less skills and resources than large scale and can easily enter to the industry
- SSCs can assist to spread the construction industry dominated by reputable large-scale contractors
- SSCs are powerful job creators within the industry
- SSCs can carry out small projects at remote areas which are not attractive to large scale contractors
- Can work at more competitive prices due to low overhead cost
- Providing infrastructure facilities needed to improve living conditions and minimizing the extreme unemployment and poverty

2.3 CURRENT QUANTITY SURVEYING PRACTICES IN CONSTRUCTION INDUSTRY

As a prominent career in the construction industry, quantity surveying enhances value to the contractual and financial management of construction projects (Dada & Jagboro, 2012). Quantity surveying can be described as a combined profession of economics, accounting, management, law, information technology, measurement and construction technology which play a vital role in all economic sectors (Ashworth et al., 2013). Fanous (2012) defined, quantity surveying as a combination of various other disciplines in a unique framework of the construction environment. Though, the final objective of the quantity surveyors is to enable the optimal value for the money spent in the construction industry, direct clients on the cost and provide implications for design decisions on value (Fanous, 2012). Currently, QSs have been integrated into other industries such as insurance, manufacturing, finance, valuation and taxation (Hemajith, Perera, Amarathunga, & Ginige, 2007).

Nkado & Meyer (2001) emphasized that, the necessity of the quantity surveyor has been changed with time on several aspects of adding value for the construction industry, even beyond the mere consideration of financial terms, from pure cost substitutable design choices to proactive recommendations, while giving the greatest value to clients considering time, cost and quality. Quantitative surveyors play a significant role all over the project life cycle, from preliminary stage to procurement and construction stage, while processing contract claims and unforeseen financial pressures to ensure the completion of construction projects (AIQS, 2012). Yogeshwaran et al. (2014) mentioned that quantity surveyors, as a career that always faces challenges and new opportunities, therefore requires unique competencies to stand out in present and future practice. According to the AIQS (2012) and RICS (2012) there are some major competencies expected from quantity surveyors such as interpersonal skills, cost management, contract administration, procurement and tendering, project finance control and reporting, project programming and planning, conflict avoidance and management, construction technology and environmental services, dispute resolution, economic analysis, cost planning, insurance costing, risk management, quality assurance and building information management.

2.4 POOR QUANTITY SURVEYING PRACTICES OF SMALL SCALE CONTRACTORS

SSCs generally believe that, they do not need a strategic plan to make profits and they can get profits easily by winning the bidding process, so they tend to offer lowest price conceivable by only considering short term profits (Handayani, 2017). However, SSCs in developing and minor developed countries still face complications and problems that hinder and complicate their activities and growth (Mahembe, 2011). Those who succeed in winning lucrative contracts will only get inadequate profits if they are able to finish the project effectively (Thwala & Mvubu, 2009). Financial management skills of QSs assist contractors to better handle their financial situations and let them know when and where to spend money to keep the company functions steady (Nagalingam, Jayasena, and Ranadewa, 2013).

The relative low performance of SSCs is mainly due to insufficient funds and the failure to obtain credit facilities from suppliers (Thwala & Phaladi, 2009). As per the author, these failures are due inability to hire experienced workers, poor pricing of BOQs, poor skills in tendering and contract documentation, poor progress monitoring, absence of adequate training, absence of resources, lack of technical, financial, contractual and managerial skills and delayed payments for completed works. Further Kulemeka, Kululanga, & Morton (2015) highlighted some more poor QS practices such as unable to obtaining interim payments on time, difficulties in procuring work, unable to identifying claims, unable to claim variations, inappropriate contractual conditions, arise of contract disputes, didn't meeting contract deadlines, incomplete contract documents, unable to providing reliable tenders and breach of contracts due to carelessness. Authors further highlighted that poor quality of services, inability to finish projects on time, inadequate tender preparation skills and poor valuation skills were key shortfalls among SSCs.Contractors have lack of abilities to accurately program capitals for proper cash flows of projects in scheduled segments, because of absence of confidence, front loading is not permitted for them and also they do not know how to prepare interim payment applications for timely payments (Illangakoon, 2017). Further author mentioned, there is a high impact on payment delays due to some poor QS practices of contractors. Assaf, Srour, and Hassanain (2013) recognized some QS related causes of contractor failures as lack of experience, weak skills in bidding and pricing, poor practices in estimations, poor usage of project management techniques and poor cash flow management. Due to these poor practices**,** the small contractors' encountered problems such as client's delays in payments, difficulties in preparing documents accurately, strict contract conditions experienced in projects, imposing significant restrictions, inability of winning the tenders, bad decision making and cash flow issues (Thwala & Mvubu, 2009).

3. Research Methodology

In depth literature survey was conducted as the first step after referring journals, books, thesis and conference proceedings which were accessible in the e-databases in order to find current status related to the research area. As per the Yin (2009), among two types of research approaches called qualitative and quantitative, for this research qualitative approach is more suitable since there are low number of respondents, low awareness of respondents on the poor QS practices of SSCs and being a novel topic. Further this research was associated with the concept of quality, which means this phenomena connected to involving quality or kind.

3.1 DATA COLLECTION TECHNIQUES

This research was designed to identify impact of poor QS practices on SSCs and get ideas from each parties of the small scale constructions. Therefore, pre-organised questions were not suitable for the interviews and 1 hour face to face semi structured interview sessions were carried out as data collection method to identify the industrial opinions of the poor quantity surveying practices of the SSCs. Nine expert interviews were adopted with owners of SSCs, consultants and clients in the industry that working with the SSCs selected through the convenience sampling method by considering, experience in construction industry, experience in small and medium scale constructions and experts in quantity surveying. The reason for selecting the convenience sampling method was inability to access the total population due to time and cost constrains.

3.2 DATA ANALYSIS TECHNIQUES

Data analysis was mainly followed with collected data from the literature review and expert interviews by analysing, classifying and organizing facts, determine whether the evidence supports the initial data analysis of research project (Rowley, 2002). In here manual content analysis was adopted to analyse data to determine the interrelationships and discrepancies in perspective of expertise interviewees for the proper presentation of research data.

4. Data Analysis And Research Findings

4.1 PROFILE OF INTERVIEWEES

The interviewees were chosen with due regard to their experience, area of involvement and sensitivity to the subject area of the current research objectives. The details of the interviewees are represented in the following table 1.

Table 1, Details of Interviewees

Interviewee	Contractor/ Consultant	Designation	Experience	Working sector
R1	Contractor	Owner	21 years	Private and Public
R2	Contractor	Owner/PM	15 years	Private and Public
R3	Contractor	QS	8 years	Private
R4	Consultant	QS	7 years	Private and Public
R5	Consultant	QS	12 years	Private and Public
R6	Consultant	QS	6 years	Public
R7	Contractor/ Consultant/Client	Assistant Manager	8 years	Private
R8	Client	TO	6 years	Private
R9	Client	QS	18 years	Private

From the total sample of interviewees, 33% were selected from contractor organizations, 45% from consulting organizations and 22% from client organizations. Further, 56% of interviewees have experience between 5-10 years, 22% has 10-15 years, 11% has 15-20 years and again 11% has more than 20 years of experience. The overview indicates that the respondents have extensive experience and the reliability and information accuracy of the input obtained.

4.2 QUANTITY SURVEYORS INFLUENCE ON SMALL SCALE CONTRACTORS

All interviewees agreed that, quantity surveyors can do huge impact on Sri Lankan SSCs' performance. The interviewee R5 mentioned there was considerable impact on SSCs from QSs by highlighting whether the project is small or large. Interviewee R6, R7 and R1 mentioned most of the times small scale contractors are not employing qualified QSs for such small works like preparation of interim valuations. Interviewee R3 agreed that, "*Owners of small-scale construction companies and technical officers of clients tend to do QS works by them-selves*". Further interviewee R7 indicated that, without qualified QS they could not precisely identify risks such as legal risks, technical risks, financial risks, managerial risks and communication risks when they enter in to contract or particular work without any agreement. Moreover, interviewee R7 further described, most probably SSCs are unable to claim all work done and variations due to lack of knowledge on contractual clauses and contract documents. Therefore above arguments clearly denote that, there is a huge impact on SSCs from QSs.

4.3 COMPETENCIES OF QUANTITY SURVEYORS IN SMALL SCALE CONTRACTORS

According to the interviewee R4, QSs in small scale contractors should have the required competencies; otherwise they cannot perform and survive in the industry. According to the all interviewees, there are some competencies not much required for the functions of SSCs from the identified list in literature. As per the analysis of respondents, below tables 2 consists the required and not required competencies list under key competencies.

Table 2, required and not required competencies of QSs

Business Administration		Construction Management	
Required	***Not required***	***Required***	***Not required***
Co-operate Recovery and Insolvency	Research and Development	Contract Administration	General Procurement Advice
Team work		Resource Analyze	Construction Audit
Communication		Risk Management	Quality Assurance

Business Management Leadership		Contract Documentation	
Client care		Tendering Process	
Construction Technology		Value Management	
Required	***Not required***	Capital Allowance	
Construction technology	Sustainability	Special Assessment	
Health and Safety		Project Management	
Construction Information Technology		**Construction Economics**	
Required	***Not required***	***Required***	***Not required***
Computer Service		Cost Planning	Statistical Analysis
Construction Law		Cost Estimating	Life Cycle Cost Analysis
Required	***Not required***	Cash Flow Monitoring	Feasibility Study
Ethics and Professional Conduct	Dispute Resolution		Property development
Government Law and Regulation	Expert Witness		Strategic Planning

As per the above table majority of the competencies of QSs were identified as significant for the small contractors and only few competencies are not highly important for the small scale contractors such as general procurement advice, construction auditing, quality assurance, research and development, statistical analysis, life cycle cost analysis, dispute resolution, expert witness, property development and strategic planning. As per the all interviewees, most of these competencies are useful in construction of mega projects. Additionally Interviewee R8 suggested that, "*knowledge sharing ability and team management would be useful in performing well for SSCs in Sri Lanka".* According to the interviewee R5, "*It is better to have cash flow monitoring for small scale contractors, because their financial strength is limited compared to other type of contractors, to avoid any losses and to maintain consistency of cash throughout the project life cycle. Therefore, Cost monitoring is essential for small scale contractors to ensure the project completion within the budget*". Further, consultant and client interviewees notified that, if QS in SSCs have value management skills they can improve their organizations performance in considerable way.

4.4 POOR QUANTITY SURVEYING PRACTICES AND ASSOCIATED ISSUES IN SMALL SCALE CONTRACTORS

In the literature, several poor QS practices and associated issues were identified which are affecting to the small-scale contractors and applicability of those issues to the Sri Lankan context was discussed with the opinions of the interviewees. All interviewees highlighted that, considerable improvement of small-scale contractors is not visible mainly due to poor quantity surveying practices.

Interviewee R1 stated that most of time SSCs experience delays to submit IPAs on time. Therefore, SSCs have to continue the construction process from their own cost by facing more difficulties. R4 added to this situation that, getting a tender is also very difficult, if the staff is not knowledgeable. Further interviewee R4 pointed out that, when preparing IPAs and variations, SSCs have to face disputes and other difficulties. Additionally, interviewee R5 indicated that to greater extent, a project can be lost in the contractor perspective if the quantity surveyor has not followed the project requirements and procedures. Furthermore, interviewee R7 stated most of the time both cost and time will be increased in the small constructions and quality compromising can be expected. Moreover, lot of variations might occur during the construction period. Interviewee R8 pointed out that cost control have a huge impact on clients' money allocation. Furthermore, interviewee R8 highlighted that, it will affect the profit of the contractor. As per the interviewees' opinions following poor QS practices and associated issues were listed as in table 3.

Table 3, Poor QS practices and associated issues in SSCs

Poor QS Practices	Associated Issues
inappropriate contract documentation	Contractual disputes
unable to program the project resources as monthly segments to achieve healthy cash flow	Unable to win tenders
failures to recognise the preparation of interim payment applications for timely payment	Project delays
poor pricing of BOQs	Cost overruns
poor skills in tendering and poor knowledge on tendering process	Poor performance
poor coordination	Poor construction quality
poor documentation	Delays in payments by the client
delays in obtaining interim payments	Cash flow problems
poor knowledge on conditions of contracts	
poor resolving of contractual disputes	
incomplete contract documents	
double taxation	
unable to identify claims	
unable to claim variations	

Interviewee R9 stated that main reason for the poor QS practice is unavailability of qualified QSs in the small and medium contractors. However, interviewee R1 and R2 agreed that if they recruit qualified QS, contractors can earn more money rather than their expenditure. The interviewee R9 argued that the unavailability of qualified QSs are affected due to the fact that contractor's opinion of preparing IPA is the only capability of QSs and they have lack of knowledge about the competencies of QS. Furthermore, interviewees who represent consultants, described that negligence was the major reason for the poor QSs practices of the small contractors. Respondent R3 stated that some contractors think in-depth training causing a non-essential expense and expect new employees to learn on the job from supervisors and experienced employees. According to interviewees there are some reasons affecting the poor QS practices of the SSCs such as lack of knowledge and experience, poor communication skills, poor coordination with others, less commitment, lack of knowledge on conditions of contract, inadequate knowledge about quantity surveying practices, inadequate technical skills, lack of training and lack of supervision. In addition, newly employed employees do not have all the competencies that are usually required to perform their jobs well. Respondent R3 stated that some contractors think in-depth training causing unnecessary expenses and expect new employees to learn on the job from supervisors and experienced employees. Though, this type of training is often insufficient and creates many difficulties for the company and employees.

4.5 SUGGESTIONS TO OVERCOME ISSUES DUE TO POOR QUANTITY SURVEYING PRACTICES OF SMALL-SCALE CONTRACTORS

4.5.1 Government / Regulatory Body Involvement

According to the interviewee R3, government has the responsibility to advice the small-scale contractors regarding the advantages of having QS in-house to get more performance. Responsible organisations like CIDA can assist to organize that kind of awareness programs. Further interviewees described that their long-term practice is to get another profession to do the QS job. Therefore, by imposing laws and regulations, government can change their mal practices. If the government can also offer tax relieves to such kind of small scale contractors like mega projects, they can hire professional QSs with that savings. Interviewee R7 argued that a formal procedure should be established to improve the skills of small-scale contractors such conducting CPD sessions. However, a mandatory legal requirement should be established for small scale contractors to participate in those CPD sessions.

4.5.2 Client / Consultant Involvement

Interviewee R2 stated that, if small contractors can maintain a healthy cash flow, they can recruit qualified QS to minimize poor QS practices. Therefore, consultants and clients have a responsibility to

give payments to small contractors on time without delaying unless there is a contractor's fault. Further interviewee R9 suggested that consultants or clients should implement conditions for the contractors in projects to have qualified QSs. If employers implement those conditions in practice, the poor QS practices could be eliminated from the small scale contractors.

4.5.3 Contractor Involvement

According to the interviewees, there are some methods to mitigate poor QS practices such as use experienced and qualified professionals, provide well-coordinated training facilities, supervision of the works, coordinate with other professions, improving training programs, adopt new technologies, keep clear and completed drawings and specifications, proper site investigation prior to constructions, use cost and time controlling techniques and maintain good record keeping. Most of the time small scale contractors followed quality compromising issues because they expect small percentage of profit from each cost element. Contractors must tend to avoid this because reworks would definitely happen and it would also be damage to the reputation of the contractor.

5. Conclusion

Small scale contractors play a comparatively negligible role in development and transitional growth of the country. Quantity Surveyors play an extensive role in SSCs throughout the project life cycle, from inception to completion by cost management, cost processing, administrating contracts and controlling unexpected financial pressure. As per the literature review and semi structured interviews of the research, performance of the small-scale contractors is not adequate level in Sri Lanka. Poor quantity surveying practices are the major factors affecting to the current performance of SSCs. Through this research, it has been strongly recommended that practice of good quantity surveying is more important to maintain the performance of the small scale contractors. Moreover, by mitigating the identified reasons for poor QS practices of contractors, they can enhance the quality of small-scale constructions. With the findings of the research, it has been noted several solutions for the poor QS practices which are recommended to the government, regulatory bodies, consultants, clients and contractors. Government or regulatory body (CIDA) have a huge responsibility to contribute for the improvement of the small contractors. Government serves as the largest single client in the construction industry in Sri Lanka and the government's sole aim is to raise the living standards of the general public by providing their requirements. Therefore, government must implement new strategies and techniques to standardize the small scale constructions. Furthermore, a better attention must be needed for the SSCs in addition to the registration and grading them from the government or the regulatory body. Further researches can be conducted to identify the impact of financial barriers that affect the performance of small-scale contractors and impact of poor QS practices on the profits of SSCs.

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IMPACT OF COMPETITIVE FORCES TO THE CONTRACTORS IN SRI LANKA: AN INDUSTRY ANALYSIS USING PORTER'S FIVE FORCES

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Abstract
The nature of the business environment is very complex in the construction industry. Huge capital investment, supply chain management, resource scarcity and uncertainty create a multifaceted background along with impressive external environmental impacts. Thus, contracting organizations are highly influenced by the competitive nature of the construction industry. Hence identifying the impact of competitive forces to the contractors in Sri Lanka is identified as vital. Besides, Porter's five competitive forces model is grounded to interpret the competition through external environment and it denotes that there are five forces which can affect to the competition of an industry; new entrants, suppliers, buyers, substitutes and the existing competitors. Thus, the research leads to examine the impact of competitive forces to the contractors in Sri Lanka using a comprehensive Porter's Five Forces analysis. The research employs a quantitative approach consisting of preliminary survey of experts and questionnaire survey with the participation of construction experts in Sri Lanka. In order to analyse the collected data, statistical tools such as RII method and measurements of central tendency were employed. The results of the analysis elicited 28 significant factors that determine the power of the five competitive forces on local contractors. Accordingly, the final outlined Porter's five forces analysis matrix enables the contractors to analyse the impact of each competitive force through identified determinant factors which would provide a proper guidance on determining necessary offensive or defensive strategies to be taken to survive in the market.

Keywords: *Porter's five forces; Construction industry; Contractors; Competitive environment*

1. Introduction

The productivity of the construction industry has significant impact on the economic growth of any country (Amarasekara, 2018). However, the construction industry is one of the main pillars in the Sri Lankan economy. In recent past, there has been an upward trend of construction activities in Sri Lanka creating a competitive environment inside the construction industry, especially among contractors (Perera et al., 2019). Moreover, due to the foreign contractors' incorporation in the construction industry, Chinese and Indian contractors in Sri Lanka with the possession of an adequate number of craftsmen, labour force, machinery and finance place them in a comparative advantageous situation over Sri Lankan local contractors (Amarasekara, 2018). Hence, the existing competitive environment among contractors can be identified. Hence, to determine accurate and appropriate business strategies to the situation, it is necessary to recognize the nature of the changing business environment and market competition. A firm's strategic planning decisions are greatly affected by the environ-mental forces in the firm's operating market (Korkmaz & Messner, 2008; Porter, 2008).

Therefore, in 1979, Michael E. Porter introduced "Porter's five forces" to formulate competitive strategies to different sectors as it was a revolution in the business strategy field (Porter, 2008). Therefore, it is a sensible and appropriate tool to analyse the market competition in the construction industry. In doing so, Porter's five forces could be used to identify the industry competition through five forces namely, new entrants, buyers, suppliers, substitutes and existing rivals. Although local contractors are often affected by the market competition and competitive forces, no such study has been carried out yet in the local context, especially considering Porter's five forces. Even though industry competition influence on company's profitability and its survival within the industry through competitive forces as mentioned in Porter's five forces, lack of researches can be identified in the research lexicon due to the existing gap. Thus, the requirement has arisen to identify the strength of each competitive force as to ultimately develop Porter's five forces analysis for the construction industry in Sri Lanka.

2. Literature Review

A comprehensive literature on Porter's Five Competitive Forces in construction industry is carried out considering each competitive force namely, rivalry among existing firms including power of the suppliers, power of the buyers, the threat of substitutes and threat of new entrants as discussed below.

2.1 REVIEW OF PORTER'S FIVE COMPETITIVE FORCES IN CONSTRUCTION INDUSTRY

Gnjidic (2018) explains, insufficient analysis of the business environment can create bias situations in the company's strategic planning process. Further, identification of the company's position in its micro- environment could be helpful to define strengths, weaknesses, opportunities and threats which will affect the profitability of the company. These five forces denote rivalry among existing firms including power of the suppliers, power of the buyers, the threat of substitutes and threat of new entrants as shown in figure 01.

Figure 1, Porter's five forces framework (*Source: Porter,2008*)

The market competitiveness is being influenced by these five forces and thus, collective power of all forces finally defines the potential profit (Korkmaz & Messner, 2008; Eskandari et al., 2015). Therefore, Porter's five forces model can be used to analyse the competitiveness in current business environment in the construction industry as discussed below.

2.1.1. Threat of new entrants

According to Eskandari et al. (2015), when new entrants arrive into the market, they are willing to acquire a portion of market share and thus, establishing new capacities. As they accelerate industry competition consequently, it could bring down other company's profitability (Mathooko & Ogutu, 2015). Hence, in Sri Lanka, there are several government regulations to be followed by new entrants when entering into the construction industry as contractors. As per CIDA, there is a specific national registration and grading scheme for construction contractors. Moreover, CIDA registration is a mandatory requirement to obtain government contracts which would create a challenging situation for a new contractor. Further, the changes in political policies such as free trade agreements could provide local firms, the opportunity to enter the international market (Korkmaz & Messner, 2008). Therefore, new entrants have both barriers and opportunities while entering to the market.

2.1.2. The power of suppliers

The construction industry is a supplier dominated industry (Kale & Arditi, 2002) and construction companies are usually dealt with construction materials, equipment and etc. The building material prices are often rising due to currency devaluation and inflation in Sri Lanka (Weddikkara & Devapriya, 2000). The government has granted duty free material imports which has restricted the domestic manufactured cement prices (Weddikkara & Devapriya, 2000). According to BOI (2019), import volume indices of investment goods and building materials has been increased by 20% to 23% in 2016 denoting the positive expansion of the construction industry in Sri Lanka. Hence the power of material suppliers is a critical factor in the competitive construction industry.

Companies have various supplier groups to obtain their inputs including labour suppliers as a key category. Non availability of skilled workforce has become a critical issue in the current construction industry (De Silva, et al., 2014) and thus, the labour suppliers have become more powerful by setting higher prices due to the higher demand (Eskandari et al., 2015). Finance as a significant factor related to suppliers in the construction firms (Amarasekara, 2018; Bandara, 2014), suppliers are paid through fund expansions, purchasing fixed assets and funding working capital requirements in the company (Department for Business Innovation and Skills, 2013). Therefore, suppliers have spread their power drastically in the construction industry.

2.1.3. The power of buyers

In the construction industry, government acts as a major client or a market intervener (Ericsson, et al., 2005). It influences the demand of the construction industry by changing fiscal and monetary policies. According to Bandara (2014), complex and special kind of projects require especially capable contractors who are limited within the industry. In such situations, customers' bargaining power will be neglected in Sri Lanka. Central Government Ministries, Authorities, Departments, Provincial Councils and Local Government Authorities are public sector clients of the construction industry and their role is vital (Gunawardhana & Jayalath, 2017). Thus, client as the most influential character in the project procurement can directly impact to the contractors.

2.1.4. The threat of substitutes

According to the recent publication of CCISL (Chamber of Construction Industry Sri Lanka, 2019), modular construction has been one of the trends that has shaped commercial construction in 2019. As an example, prefabricated building components and modular building systems has become an accepted solution for the scarcity of skilled labour in traditional Sri Lankan construction industry (Gunawardena et al., 2016). Therefore, availability of substitutes has a considerable impact towards the market competition. Moreover, substitutes can be highly invented with the advanced technologies.

2.1.5. Rivalry between existing competitors

Construction contracting has become more competitive due to the tender selection procedures and thus, the tender price should be included with a lower profit margin to win the projects in a typical scenario (Hampson & Kwok, 1997). Under this force, market rivalry means competitive intensity in terms of competition among local and international companies (Eskandari, et al., 2015). Abidin et al. (2008), stated that the domestic contractors face complications when competing with foreign contractors due to their relatively lower financial capabilities.

Even though foreign collaboration enhances local construction capacity by knowledge and technology transferring (Bandara, 2014), later it has also become an unfair competition to the local contractors (De Silva et al., 2014). Thus, the construction market rivalry between contractor organizations has been increased. Therefore, there is an intense competition between contractors with each other to obtain the construction projects.

Since the literature identifies various factors to be considered under all competitive forces as discussed before, Table 1 indicates the Porter's five forces and the determining factors under each force derived through literature.

Table 1, Significant Factors in The Sri Lankan Construction Industry

Threat of New Entrants		
	Factors (Entry barriers)	**References**
1	Capital requirement	(Porter, 2008; Mathooko & Ogutu, 2015; Eskandari et al., 2015)
2	Contractors' ability to access to distribution channels	
3	Government and other restrictive policies	
4	Competitors' reaction	
5	Contractor's economies of scale	
6	Customers' benefit from economies of scale	
7	Customers' switching cost (Cost incurs as a result of changing contractors)	
The Power of Suppliers		
	Factors	**References**
1	Supplier's input is critical for the production	(Porter, 2008; Mathooko & Ogutu, 2015; Eskandari et al., 2015)
2	Suppliers' concentration in the industry	
3	Non-Availability of substitutes for suppliers' products/services	
4	Suppliers' product differentiation	
5	Suppliers with more important customers	
6	Forward integration	
7	Contractors' switching cost	
The Power of Buyers		
	Factors	**References**
1	Number of buyers in the market	(Porter, 2008; Mathooko & Ogutu, 2015; Eskandari et al., 2015)
2	Product standardization and differentiation	
3	Availability of large-volume buyers	
4	Vitality rate of the product/service	
5	Buyer's switching cost	
6	Backward integration	
The Threat of Substitutes		
	Factors	**References**
1	Price- performance trade off	(Porter, 2008; Mathooko & Ogutu, 2015; Eskandari et al., 2015)
2	Availability of substitutes	
3	Switching cost to the substitutes	
Rivalry among Existing Competitors		
	Factors	**References**
1	Contractors with equal size and power	(Porter, 2008; Mathooko & Ogutu, 2015; Eskandari et al., 2015)
2	Concentration of the contractors in the industry	
3	Industry growth rate	
4	Product differentiation	
5	Switching cost of buyers	
6	Exit barriers from the industry	
7	High fixed cost and low marginal cost	

However, it is necessary to recognise appropriateness of each factor to the Sri Lankan construction industry in order to decide power of each force in the local context. In doing so, prevailing influence of each factor on the contractors is required to be analysed in depth.

3. Research Methodology

Amarasekara (2018) describes, a quantitative approach is most suited for assessing the relationships among different variables using statistical and graphical tools. The study consists of predetermined list of factors which requires to determine the significant factors to the Sri Lankan construction industry based on the values derived through statistical analysis. Therefore, quantitative data approach is best suited for the study.

Primarily, a comprehensive literature review was carried out to discuss on the Porter's five forces and to identify the determining factors under each force through the survey of books, journal articles, periodicals, conference proceedings, annual reports and etc. Then a preliminary expert survey was

conducted with the participation of three experts to refine determining factors of from five forces within the Sri Lankan context and to further identify any additional factors relating to the context. Based on derived factors through preliminary survey, a questionnaire was prepared and the distributed among 161 experts who are working in the contractor organizations with more than 5-year experience in construction industry and yet, 108 was responded. Respondents were asked to determine the significance of each factor in the given criteria using the Likert scale from 1-5.
To ensure a better demonstration of the competitive nature of the current Sri Lankan construction context, the study was limited to the participants from contractor organizations having C1, CS1 or CS2 grading to collect data. The convenience sampling method was used to collect the data considering the easiness to reach the questionnaire respondents as the selected respondents represent the total population. Subsequently, RII (Relative Important Index) was used to analyse the collected data and thus, to identify the most significant determining factors under each competitive force considering the Sri Lankan context.

4. Data Analysis and Research Findings

Based on the findings of preliminary survey, the existing factors derived through literature were refined within the Sri Lankan context and additional factors were also suggested as shown in the Table 2. Factors R1, R2, R3, R4, R5, R6, R7, R8 & R9 were rejected as the determining factors of Porter's five forces in the Sri Lankan construction industry. Further, 07 additional factors exist in the current industry were suggested which are illustrated in the Table 2. The refined list of factors was considered to be applicable within the local context.

The analysis of the questionnaire survey findings demonstrates the relative importance (RII) of each factor under all five competitive forces which is summarized in table 2. Thus, all factors were ranked based on their RII value considering their applicability in the Sri Lankan context to determine competitiveness among contractors.

Table 2, Determining factors of Porter's five forces

Threat of New Entrants			
	Factors (Entry barriers)	**RII**	**Rank**
S1	Capital requirement	87%	1
S2	Contractors' ability to access to distribution channels	79%	2
S3	Government and other restrictive policies	77%	3
S4	Competitors' reaction	71%	4
A1	Corruption	70%	5
R1	Contractor's economies of scale		
R2	Customers' benefit from economies of scale		
R3	Customers' switching cost (Cost incurs as a result of changing contractors)		
The Power of Suppliers			
	Factors	**RII**	**Rank**
S5	Supplier's input is critical for the production	88%	1
S6	Suppliers' concentration in the industry	82%	2
S7	Non-Availability of substitutes for suppliers' products/services	81%	3
S8	Suppliers' product differentiation	77%	4
S9	Suppliers with more important customers	76%	5
A2	Product recommendation from Employer/Consultant	75%	6
A3	Only affordable good technology option	74%	7
A4	Availability ex stock	71%	8
A5	Proven and time-tested products	71%	9
R4	Forward integration		
R5	Contractors' switching cost		
The Power of Buyers			
	Factors	**RII**	**Rank**
S10	Number of buyers in the market	85%	1
S11	Product standardization and differentiation	83%	2
S12	Availability of large-volume buyers	81%	3
S13	Vitality rate of the product/service	80%	4

A6	Repetitive buyers	74%	5
A7	Early payment scheme of buyers	71%	6
R6	Buyer's switching cost		
R7	Backward integration		
The Threat of Substitutes			
	Factors	**RII**	**Rank**
S14	Price- performance trade off	79%	1
S15	Availability of substitutes	78%	2
S16	Switching cost to the substitutes	74%	3
Rivalry among Existing Competitors			
	Factors	**RII**	**Rank**
S17	Contractors with equal size and power	91%	1
S18	Concentration of the contractors in the industry	82%	2
S19	Industry growth rate	81%	3
S20	Product differentiation	74%	4
S21	Switching cost of buyers	71%	5
R8	Exit barriers from the industry		
R9	High fixed cost and low marginal cost		

S	**Selected**	**R**	**Rejected**	**A**	**Additional**

There are five relevant entry barriers incorporated under the first competitive force in order to identify the threat from new entrants. Among them, "Corruption" has been identified as a new factor that acts as an entry barrier in this industry. Further, Capital requirement is identified as most important factor among all factors. Accordingly, these entry barriers restrict the entrance of new contractors in Sri Lankan construction industry.

Altogether there are nine factors that could influence the power of suppliers including four new factors identified through the preliminary respondents. As De Silva et al. (2014) stated that non availability of resources would increase the power of suppliers whereas the study also agrees with the statement by denoting "non-availability of substitutes for the suppliers' products or services" as the most critical factor. However, forward integration and contractors' switching cost were rejected considering the expert opinion.

The third force "power of buyers" demonstrates six determining factors in local context including "Repetitive buyers" and "Early payment schemes of buyers" as new factors. Referring to the literature, construction industry has large scale buyers who claim to have more power to bargain with the contractors (Gunawardhana & Jayalath, 2017) which is further proved through the findings of questionnaire survey reporting the highest RII value by the factor "Number of buyers in the market".

Fourth force ''threats of substitutes" stay remains with three determining factors identified through literature even after the preliminary expert survey. The factors ''Price- performance trade off" and ''Availability of substitutes" could be further backed up through the literature, exemplifying the extensive applicability of prefabricated building components and modular building systems in current local construction industry due to their cost effectives (Chamber of Construction Industry Sri Lanka, 2019). Ultimately, fifth force deliberates about '' the competition between existing contractors" with five key determinants under it. Referring to literature, presence of large number of foreign construction firms has caused to increase the competition between domestic contractors (De Silva et al., 2014; Bandara, 2014) which agrees upon the study findings.

Afterwards, each competitive force was assessed considering form of current prevailing influence on the contractors. Thus, respondents were asked to indicate the current influence of each force in the form of either positive, negative or neutral. However, based on the mode value calculations, findings denoted that all the forces except ''threat of new entrants" make a 'positive' impact on the contractors in the local construction industry while ''threat of new entrants" reports a neutral impact based on the mode values. Thus, resembling the study findings so far, develop Porter's five forces analysis was developed for the construction industry in Sri Lanka.

Thus, the current influence of the Porter's five forces through each relevant factor to the contractors in Sri Lanka is denoted in the figure 2. Initially, the figure 2 explores the external environment and it begins from the macro environment. Subsequently, the industrial environment is denoted under the five key determinants namely, new entrants, suppliers, buyers, substitutes and the existing competitors. Porter's five competitive forces are initiated from these elements and those five forces could be further elaborated with the derived determining factors considering the local construction industry. Altogether 28 determining factors were identified under all five forces.

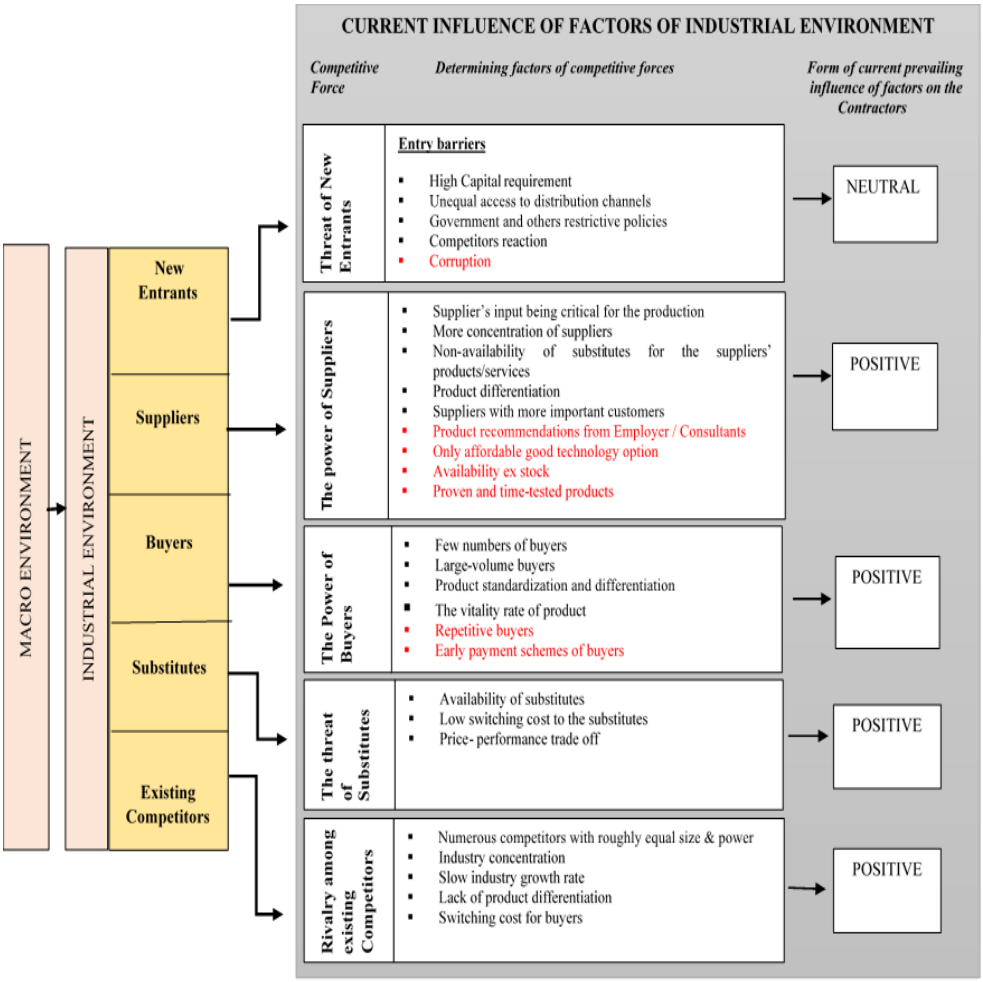

Figure 2, Porter's five forces analysis for contractors in current construction industry in Sri Lanka

Thus, the Porter's five forces analysis was developed identifying key determining factors related to local construction industry.

5. Conclusions and Recommendations

Competitive environment is a key determinant for the success of a construction business. The current construction industry has intense competitive environment whereas contractors compete with each other to acquire the projects. During last ten years, Sri Lanka has reached to an admirable development in residential, commercial, hotel and resort construction and infrastructure sectors. As a result, competitive environment among contractors has gradually been increased.

Porter's five forces analysis elaborates that "existing competitors" is not the only factor that causes the competition. Evidently, there are four other factors, namely new entrants, suppliers, buyers and the

substitutes. Hence, in order to determine competitiveness among contractors, all five key forces should be considered. Based on an extensive analysis carried for the Porter's five forces considering the Sri Lankan construction industry, 28 determining factors were denoted including seven additional factors derived through respondents' suggestions. Among those factors, some are identified as crucial to determine the competitive nature among Sri Lankan contractors; Capital requirement, Contractors' ability to access to distribution channels, Supplier's input, Number of buyers in the market, Product standardization and differentiation, Availability of substitutes, Contractors with equal size and power.

Hence, it is contractors' duty to consider all those factors to decide upon competitive strategies while overcoming challenges from existing competitors by confirming their survival in the industry. Considering the influence of each force on local contractors, only 'Threat of New Entrants' shown to be neutral. Besides all the other four forces, 'The Power of Suppliers', 'The Power of Buyers', 'The Threat of Substitutes' and 'Rivalry among Existing Competitors' have made positive influences on the contractors in the current local construction industry which would ultimately upsurge the competitiveness among the contractors, thus in the construction industry as a whole.

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AN INVESTIGATION ON CORPORATE SOCIAL RESPONSIBILITY OF CONSTRUCTION ORGANISATIONS IN DISASTER IN SRI LANKA

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Abstract
Corporate Social Responsibility (CSR) is a concept, which is broadly determined as ensuring the efficacy of the organisation in integrating social and environmental considerations into organisational operations. In Sri Lankan context, a great enthusiasm can be seen among organisations to engage in CSR initiatives. Having considered the importance and impact, the study aims to investigate the importance of CSR initiatives by construction organisations in disasters in Sri Lanka. Thus, a mixed method research approach was followed as the methodology of this study. Findings are based on semi-structured interviews held with construction industry professionals. Findings of this study revealed that the implementation of CSR initiatives is more important during a disaster situation in the aspects of both affected party and aiding party. Moreover, construction organisations implement CSR during disaster situations by considering it as a mandatory responsibility of an organisation. Further, most of the construction organisations engage in CSR implementation during natural disaster situations. In practice all the construction organisations tend to engage in reactive initiatives. More importantly, it is revealed that both the organisational work force and society are benefitted through CSR implementation in disaster situations.

Keywords: *Construction organisations, Corporate Social Responsibility, Disaster, Sri Lanka*

1. Introduction

Over the last few decades, an extensive spread of CSR initiatives can be seen within the global community (Pisani, Kourula, Kolk, & Meijer, 2017). The term CSR is initially formalized by Bowen (1953) by emphasizing the requirement of undertaking social responsibilities by entities (Cheng, Jin, Hung-Baesecke & Chen, 2018). CSR is defined as "the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large" (Holmes & Watts, 2000). In CSR, environmental, social and economic considerations are integrated into the strategies and practices, which are followed within an organisation (Abram & Jarzabek, 2016). Liu, Fellows, and Tuuli (2011) pointed out that under CSR, an organisation should fulfil four types of responsibilities as economic, legal, ethical and philanthropic. More importantly, CSR initiatives are implemented not only during routine organisational operations but also implemented during times of crisis (Cheng et al., 2018).

A disaster causes a significant impact on many people or entire community at large, whereas it causes economic losses, crimes, fear in crimes, suicides, psychological distress, population shifts and destruction of political and social units (Gallant, 2008). Haigh and Sutton (2012) highlighted the importance of implementing CSR towards disaster management as, to provide humanitarian assistance to save lives, alleviate suffering and protect and maintain human dignity during and after the disasters. Disasters require prompt, effective and well-coordinated response from government, private sector and voluntary organisations in order to reach speedy recovery (Singh, Srivastava & Singh, 2017). Due to the failures of government to launch an effective disaster management policy, organisations are highly expected to participate in response, recovery, planning, and mitigation of disasters (Johnson, Connolly & Carter, 2010).

In Sri Lankan context, organisations are seeking to adopt CSR practices (Wijerathna & Gajanayaka, 2014). Moreover, CSR initiatives in Sri Lankan organisations are under two broad categories as internal policy level and externally focused, where the externally focused refers to the initiatives which are visible to the public at large (Sheham, 2016). Author further stated that the Sri Lankan organisations are having only a general understanding on the CSR initiatives and those organisations are implementing the initiatives without an overall policy.

There is an integration of CSR into the construction industry, whereas environmental activities, workplace activities, marketplace activities and social activities are identified as the four major CSR types (Ulutas, 2012). As per Vijayaragunathan (2016), major drivers and barriers for the CSR implementation in Sri Lankan construction organisations are related to cost, government regulations, top management's philosophy, population growth, and stakeholders' pressure. Even though there seems a tendency of practicing CSR towards disaster management, the investigation on CSR implementation in disaster situations is lacking in the Sri Lankan construction industry. Hence, this paper aims to investigate the CSR of construction organisations in disasters in Sri Lanka.

2. CSR Initiatives by Organisations in Disasters

There is a growing attitude that organisations have a social obligation to act in socially, ethically and environmentally responsible way (Bhatt, 2002). The author further asserted that while doing no harm to the society, organisations have a responsibility to contribute to the well-being of the society. The aim of CSR is to make positive impacts on environment, communities, consumers and the employees (Costa & Torrecchia, 2017). More importantly, the most concerned areas of CSR implementation are community involvement, environmental concerns, welfare and charity, products and services, and disasters (natural/ man-made) (Żychlewicz, 2015). Even though CSR initiatives are implemented by concerning all above areas, CSR initiatives acquire a significant value at a disaster situation (Ramakrishnan, Hishan, Shahabuddin & Kanjanapathy, 2016). Disasters are unforeseen devastative events, which cause immense damages and community suffering (Singh et al., 2017). Engagement in CSR initiatives is an ideal way to provide aids for suffering community in case of a disaster (Behl & Dutta, 2019). As per Bhatt (2002), responding on disaster situations are considered to be humanitarian rather than being professional in nature.

3. CSR Initiatives by Construction Industry in Disasters

Generally, the construction organisations engage in six key CSR activities such as workplace, human rights, community involvement, environmental protection, marketplace and ethical business operations (Rameezdeen, 2007). The construction organisations are capable of implementing CSR initiatives at pre and post disaster stages (Moe & Pathranarakul, 2006). Nevertheless, the authors declared that the affected community mostly expects aids of construction organisations at post disaster stage. As per Bhatt (2002), any industry context should be rich in terms of essential resources such as material, human, technical expertise and financial in order to launch CSR initiatives during a disaster situation. According to Baroudi and Rapp (2014), construction industry possesses a strongly established countrywide network, which results in acquiring required resources in ample amount. Therefore, construction industry possesses a significant strength to engage in CSR activities towards disaster management.

The affected community is unable to cope with a disaster situation without an external assistance (Haigh & Sutton, 2012). Therefore, the need to manage disasters through construction industry has become vital in recent years (Sathyendrakajan, Karunasena & Wedikkara, 2012). The construction organisations engage in disaster management through building procurement, design and construction (Witt, Sharma & Lill, 2014). Moreover, the authors emphasized that the construction organisations play a major role in responding to disasters by dealing with damaged and collapsed buildings and infrastructure and providing temporary shelter and services to affected population and also in post-disaster reconstruction efforts (Matin, 2002). As per Sui-Pheng, Raphael and Kwan (2006), above disaster management activities can be implemented by coordinating many fields in the construction industry such as professionals, volunteers, voluntary welfare organisations (VWOs) and non-governmental organisations (NGOs), which are specialized in civil engineering, building, architecture and urban planning. Furthermore, CSR in disaster management can be implemented in forms of charity.

Disaster management can be classified into two main approaches as proactive approach and reactive approach (Mojtahedi & Oo, 2016). Proactive approach is referred to activities which are planned and implemented before the occurrence of a disaster and reactive approach referred to the activities implemented during and after a disaster occurrence (Moe & Pathranarakul, 2006). The key phases of disaster management are mitigation, preparedness, response and recovery (Poser & Dransch, 2010). As per Moe and Pathranarakul (2006), the proactive approach is undertaken at mitigation and preparedness phases while reactive approach is undertaken at response and recovery phases.

4. Research Methodology

Initially a comprehensive literature survey was carried out to investigate the CSR initiatives use by construction organisations globally in disaster situations. Based on the literature review, research aim was established to investigate the importance of CSR initiatives by construction organisations in disasters in Sri Lanka. In order to achieve the aim of this study, interviews under mixed method research approach were conducted among 45 construction industry practitioners attached to 45 different private sector construction organisations having CIDA Grade C2 or above using a semi-structured interview guideline. The study collected importance of implementing CSR practices in a disaster and reasons for organisational engagement in CSR during a disaster related to qualitative data, and the level of organisational commitment in natural and man-made disasters, approaches followed by construction organisations when engaging in CSR initiatives in a disaster situation, level of CSR implementation as a reactive approach by construction organisations and beneficiaries in CSR implementation in a disaster related to quantitative data in order to address the research problem. The respondent profile is shown in Table 1.

Table 1: Respondent Profile - Job Responsibilities of the Respondents

	DGM	Managing Director	Contracts Manager	HR Manager	HR Executive	System Implementation Executive	CQS	Total Respondents
Proportion of respondents	02	06	05	12	10	05	05	**45**
(%)	4.44	13.33	11.11	26.67	22.22	11.11	11.11	**100**

Quantitative data was analysed using descriptive statistics and qualitative data was analysed using code based content analysis. Finally, the findings are presented.

5. Research Findings

This study investigated the importance of implementing CSR practices and CSR initiative use by construction organisations during disaster situations in Sri Lanka. Key findings of this research study are discussed below.

5.1. IMPORTANCE OF IMPLEMENTING CSR PRACTICES IN A DISASTER

Initially it is required to identify the importance of CSR implementation in a disaster situation. Therefore, through semi-structured interview guideline, the importance of CSR implementation during a disaster situation was examined. All the respondents identified CSR as an important attribute to be actively practiced by construction organisations during a disaster situation.

The reasons for considering CSR as an important attribute to be practiced during a disaster situation was further investigated. Twelve respondents identified engaging in CSR initiatives is more important during a disaster situation in order to alleviate the suffering population by bringing them back to their

normal life pattern both physically and psychologically. For example, one respondent emphasised stating that '*when the general public have been affected from a disaster situation, there may not be any resources left with them to continue their day today life. Therefore, someone has to voluntarily help them to come back to their normal selves, in good faith*'. More importantly ten respondents raised that engagement in CSR initiatives in disasters as a fulfilment of societal responsibility.

Moreover, 06 respondents emphasised another perspective to consider CSR implementation as it provides a mutually beneficial relationship for both helping party and the affected party. Meanwhile, 05 respondents stated that CSR implementation is a better way to uplift the organisational position as a corporate body.

In the literature survey, the importance of implementing CSR towards disaster management was highlighted as, to provide humanitarian assistance to save lives, alleviate suffering and protect and maintain human dignity during and after the disasters. So the facts raised in the literature survey were confirmed in the data analysis.

5.2 ORGANISATIONAL ENAGAGEMENT IN CSR DURING A DISASTER

After identifying the respondent attitude towards the implementation of CSR initiatives, it is required to investigate the level of CSR engagement during a disaster situation by each organisation. All the respondents emphasized that they engage in CSR initiatives during a disaster situation. Twelve respondents identified that engaging in CSR initiatives as a mandatory responsibility of an organisation. For example, one respondent stated that '*Corporates are depending on the general public in various means. Therefore, it is a mandatory responsibility to attend with CSR approach to provide our helping hands during a disaster situation*'.

Eight respondents emphasized that they engage in CSR initiatives as their organisations are capable of supplying the necessary resource requirements such as labour, plant and machinery which become essential at the post disaster stage. Most of the post-disaster projects require resources for construction projects. Therefore, construction industry is the major sector who can supply that requirement effectively than other industrial sectors.

Moreover, six respondents emphasized that a certain amount in annually allocated for the CSR projects, and with the allocated budget they engage in CSR projects during disasters. More importantly, 05 respondents highlighted the higher degree of support given by the top management to engage in CSR projects.

5.3 ORGANISATIONAL COMMITMENT IN NATURAL AND MAN-MADE DISASTERS

As identified in the literature survey there are mainly two types of disasters as natural and man-made disasters. Figure 1 illustrates the degree of CSR implementation at each type of disasters which is identified through the semi-structured interviews.

As per Figure 1, 24 respondents stated that their organisations engage in CSR initiatives in natural disasters. That is 73.33% out of the respondent organisations who engage in CSR initiatives during disasters. Remaining 26.67% respondents revealed that their organisations implement CSR projects during both natural and man-made disasters. So, it is evident that most of the construction organisations mainly launch CSR initiatives in case of a natural disaster.

For the investigation on the reasons, 10 respondents emphasized that they engage in CSR projects during natural disasters as there is a higher frequency of natural disaster occurrence rather than the man-made disasters. Moreover, government directly involves in providing assistance in man-made

disasters such as wars and conflicts. So organisations get less opportunity to alleviate the suffering during and immediately after man-made disasters.

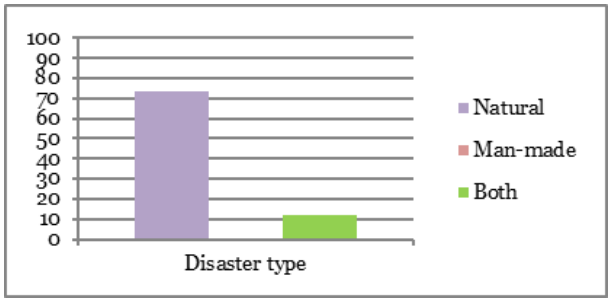

Figure 1: CSR implementation in different types of disasters

Another significant factor raised by 04 respondents is the unavailability of a responsible party for natural disasters since those are occurred naturally. Only 2 respondents highlighted that they provide relief only at natural disasters by considering the limited annual allocation for CSR projects.

5.4 APPROACHES FOLLOWED BY CONSTRUCTION ORGANISATIONS WHEN ENGAGING IN CSR INITIATIVES IN A DISASTER SITUATION

According to literature review, there are two major approaches to engage in CSR initiatives in a disaster as proactive and reactive. The research was further extended to collect the respondent's attitude on the most appropriate approach to be followed and the findings are illustrated in Figure 2.

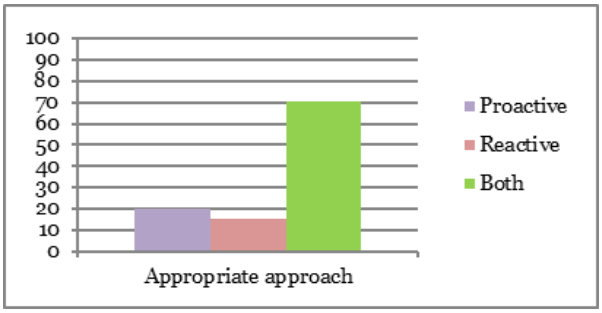

Figure 2: Respondent's attitude on the approaches to be followed when implementing CSR initiatives in a disaster situation

Although the construction organisations heavily use reactive approached, 70.73% of respondents considered that CSR initiatives should be practiced as both proactive and reactive approaches. According to one respondent, '*Most disasters are unpredictable and occur randomly. But the impact of some disasters could have been reduced by a proactive approach; still the reactive approach is also important for rectification, indemnification and improvisation*'. Moreover, another respondent raised the requirement of both prevention and reinstatement.

As per Figure 2, 20% of respondents stated the best practice is to engage in CSR initiatives as a proactive approach. According to one respondent, '*prevention is better than cure*'. Moreover, 15.56% of respondents considered reactive approach as the best suited approach to implement CSR initiatives as construction organisations can actively participate in relief programs with the prevailing resources and capabilities of their organisations.

However, for the question on actual level of interference in each approach by construction organisations, all the respondents emphasized that their organisations only follow reactive approach

when implementing CSR initiatives in a disaster situation. The major reasons highlighted by respondents for practicing CSR only as a reactive approach are the less knowledge on pre-disaster management activities, limited financial resources and lack of time. Hence, the following section presents the findings on CSR initiatives as a reactive approach by construction organisations in Sri Lanka.

5.5 IMPLEMENTATION OF CSR AS A REACTIVE APPROACH BY CONSTRUCTION ORGANISATIONS

According to literature review, reactive approach can be categorized into two stages as response and recovery. Study was further extended to investigate the organisational commitment at each stage. Figure 3 illustrates the CSR implementation in post-disaster stages by construction organisations.

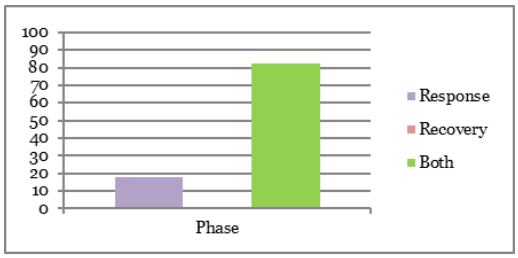

Figure 3: CSR implementation stages in a post-disaster situation by construction organisations

As per Figure 3, 82.22% respondents emphasized that their organisations implement CSR initiatives in both phases. Only 17.78% of respondents stated that their organisations implement CSR initiatives only during the response phase. It was revealed that none of the organisations engage in CSR initiatives only during the recovery phase.

After questioning about the organisational practice, respondent attitude is obtained regarding the appropriate phases to be followed. 75.56% respondents identified that CSR initiatives should be implemented in both phases. For example, one respondent emphasised that '*CSR activities can be effectively launched when those are practiced in both the phases*'. Through response phase emergency assistance can be provided, while recovery phase is required to bring back affected people to their normal life pattern both physically and mentally.

9.76% of the respondents highlighted the availability of a clear channel to address the disaster situations immediately after it's occurred. The focus on disaster management gets diminished gradually with the time. Hence, the involvement to the recovery phase is not at a better position. On the other hand, remaining 15.56% of respondents consider recovery phase as the most appropriate. As per one respondent, '*Recovery phase is the most cost intensive phase. So, it is better if the corporate organisations allocate the whole budget for recovery phase while the collective public commit to response phase*'.

5.6 BENEFICIARIES IN CSR IMPLEMENTATION IN A DISASTER

Last question in the interview guideline is based on the community which is focused by the construction organisations when implementing CSR initiatives. 80% of respondent organisations provide relief to both in-house organisational work force and to the society. Only 4.44% of respondents stated that they provide relief only for the society. Both the organisational work force and society are considered as valuable assets for a construction organisation. The organisational successfulness depends on both parties. So, 80% of the organisations implement CSR initiatives for both the parties.

6. Conclusions

The CSR is a concept, which was developing in the global context over the decades. Moreover, there can be seen an immense enhancement for CSR concept in Sri Lankan context including the construction industry. The construction organisations engage in numerous CSR projects by aiming variety of social benefits such as enhance environmental sustainability, provide welfare and charity for the betterment of the society. Moreover, there can be identified an involvement in CSR projects during disaster situations.

There are two categories of disasters as natural and man-made disasters. In any type of disaster, mainly there are two stages as pre-disaster and post disaster, whereas both the stages need an effective management. Pre-disaster situation can be managed through proactive approaches, while post disaster situation can be managed through reactive approaches. Basically, reactive approach can be implemented in two main phases as response and recovery phase. Disasters have the capability to pull down the living status of the whole community. Therefore, there emerges a requirement to provide relief for the affected community.

During a disaster situation, all most all the society get cooperated to supply aids, whereas most of them are engaging in a voluntary service. Being among the voluntary community, construction organisations also play a vital role. Assistance given by construction organisations spreads upon a wider area and it is given through engagement in CSR initiatives. They highly believe that aiding the affected community is a mandatory responsibility of construction organisations. Industry practitioners tend to supply aids mostly in case of a natural disaster. That is by considering the higher frequency of natural disasters relative to man-made disasters. Even though there is a requirement to provide assistance in both the pre-disaster and post disaster stages, more often construction organisations focus on post disaster stage of a disaster by concerning time constraints and less budget allocation.

During the post disaster stage, construction organisations engage in CSR implementation both as response phase activities and recovery phase activities. That is by concerning the effectiveness achieved through engaging in both the phases. During the response phase, CSR initiatives are implemented to provide emergency assistance, while CSR initiatives are implemented in recovery phase in order to alleviate the suffering by bringing back affected community to their normal life pattern.

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IMPLEMENTATION OF SCL PROTOCOL TO ENSURE THE CONSTRUCTION SUSTAINABILITY DURING THE EXECUTION STAGE

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Abstract
In the Sri Lankan construction industry, the wrong industry practices and undefined areas about delay and disruption in the contract causes the disputes. Significantly, the disputes cause controversial issues in the quality of the working relationship. Accordingly, the negative impact on the working relationship affects construction sustainability during the execution stage. Here, the implementation of the SCL protocol for the claim management would overcome the above mentioned problem. The aim of the research was designed with modifying the SCL protocol to best suit the Sri Lankan claims management and hence to improve quality of working relationship. Thus, the expert interviews from five experts set out the feasibility and practicability of the SCL protocol in Sri Lanka. Here, the experts having more than 10 years of experience in claims management were selected through snowball sampling and the collected data was analysed through code based content analysis using NVivo. Finally, the suggestions for the modification of the core principles in SCL protocol to match with the current Sri Lankan practices and the practical difficulties to implement the SCL protocol were determined. Ultimately, the modification and implementation of the SCL protocol together would enhance the construction sustainability during the execution stage.

Keywords: *Disputes, Delay and Disruption, Sustainability, SCL protocol.*

1. Introduction

Sustainable development has significant impacts on the evolution of the construction industry (Ahmad, Mazhar, Laedre, Bruland, & Torp, 2019). In fact, it is the responsibility of the construction industry to attain sustainability throughout the construction process (Vatalis, Manoliadis, & Charalampides, 2011). Here, sustainable development concern about the environmental, social and economic aspects of the construction (Tan, Shen, & Yao, 2011). Narrowing to economic sustainability, the construction industry faces challenges during the different stages of construction process (Vatalis et al., 2011).

Currently, the construction professionals are looking forward to implementing sustainable policies during the execution stage (Tan et al., 2011). Accordingly, the sustainablity in the execution stage can be achieved through effective procurement and good working relationships (Jelodar, Yiu, & Wilkinson, 2013). Significantly, the working relatioship in constrction project is formed after signing the contract (Jelodar, Yiu, & Wilkinson, 2016). Accordingly, good quality relationship would minimise the excess cost associated with the construction project (Jelodar et al., 2013). Moreover, the above mentioned sustainable relationship ensure the collaboration, trust, and commitment among the professionals and enhance the overall value of the project in terms of quality, time and cost (Jelodar et al., 2016).

Construction projects often suffer from controversial issues during the execution stage due to unforeseeable situation (Pinamang, Gyamfi, Danso, & Kwame, 2018). Consequently, the above situation leads to delay and disruption in the construction projects (Keane & Caletka, 2015). Here, both delay and disruption have considerable effects on the time and cost of construction projects (Aibinu, 2009). Accordingly, the reason for the issues could be due to the vague areas in delay and disruption that are not clearly expressed in the construction contract (Jayalath, 2012). Therefore, it is vital to have a universal approach or acceptable guideline to minimize or mitigate the disputes arising out of delay and disruption in the construction industry (Taylor, 2010).

Accordingly, guidelines such as “SCL (Society of Construction Law) Protocol” and “Forensic Schedule Analysis” are developed to overcome the vague areas in the expressed conditions of the contract to deal delay and disruption claim management (Keane & Caletka, 2015). Here, compared to forensic schedule analysis delay and disruption protocol is more comprehensive (Association for the

Advancement of Cost Engineering International (AACEI), 2011). In addition, delay and disruption protocol is widely used in many countries (Braimah, 2013). Anyhow, different countries may have different national culture and hence, investigation, the magnitude of delay, causes, effects, and remedies may vary (Arditi, Nayak, & Damci, 2016). Therefore, it is required to prove the adaptability of the protocol in Sri Lanka and hence, (Pathirana & Seneviratne, 2015) have proved the feasibility of adopting delay and disruption protocol in the Sri Lankan claim management.

Even though the SCL protocol is feasible in Sri Lanka, only 33% of total respondent have practicing SCL protocol (Pathirana & Seneviratne, 2015). Hence, there is a necessity to modify the SCL protocol to best suit the Sri Lankan practices and to improve the practicality. Accordingly, the aim of the research was developed to modify the SCL protocol to best suit the Sri Lankan claims management and hence to ensure the construction sustainability during the execution stage. Eventually, the objectives were to determine the disputes arising out of delay and disruption claims, core principles in SCL protocol and adaptability of SCL protocol to Sri Lankan construction industry.

2. Issues due to delay and disruption in Sri Lankan construction industry

In Sri Lankan context, unclear areas in delay and disruption are the reason for the difficulty in establishing the fair and expeditious settlement of claims (Pathirana & Seneviratne, 2015). Here, the unclear areas in delay and disruption are referred to as improper updating programme, concurrent delays, float and selection of suitable Delay Analysis Technique (DAT) (Pathirana & Seneviratne, 2015). Further, the confidentiality on the delay analysis process is poor among the parties in Sri Lanka (National Construction Association of Sri Lanka, 2014). Moreover, the failure of notifying the claim at the right time is also a reason for the rejection of delay claims (Ramachandra, Rotimi, & Gunaratne, 2014). Ultimately, 78-90% of construction projects in Sri Lanka are suffered from time overrun, among them, 50-70% of the projects have submitted delay claims, and out of the submitted claim only 25-40% of claims were succeeded (Ramachandra et al., 2014). Therefore, the delay claims in the Sri Lankan construction industry sentence to dispute among the parties to the contract (Perera, Wijewickrama, Goonawardana, & Jayalath, 2019).The disruption claims are poorly practice in Sri Lanka due to less guidance and case law on disruption analysis, less awareness of situations, lack of records availability, level of awareness about proving contractual entitlement for recovery of the disruption event, unavailability of the proper baseline programme, lack of awareness of the disruption quantifying methodologies, concurrent disruption, and lack of skilled site staff and poor communication and coordination (Jayasena & Alwis, 2011). Ultimately, issues regarding delay and disruption should be mitigated in order to prevent the dispute situation (Pathirana & Seneviratne, 2015).

2.1. MITIGATING ISSUES IN DELAY AND DISRUPTION CLAIM MANAGEMENT

Here, issues in delay analysis can be mitigated in a fair and amicable manner through awareness and incorporation (Braimah, 2013). Consequently, above-mentioned issues in delay and disruptions can be mitigated through studying the mechanism and proper ways (Pathirana & Seneviratne, 2015). Accordingly, proper guideline for delay and disruption is required for the parties to the contract (Tan, 2012). Therefore, introducing a guideline to mitigate delay and disruption claim would be a better solution before it becomes complex (Braimah, 2008). Accordingly, most notable guidelines are SCL protocol and Forensic Schedule Analysis (Braimah, 2013). When narrowing down to Sri Lankan construction industry, a current research has identified that out of the above-mentioned guidelines only 40% of total respondents were aware of the SCL protocol and 20% of total respondent were aware of the RP-FSA guideline (Pathirana & Seneviratne, 2015).

2.2.SCL'S DELAY AND DISRUPTION PROTOCOL

SCL has published delay and disruption protocol in October 2002 (Tan, 2012). Thereafter, the 2nd edition was published by SCL in February 2017 (Society of Construction Law (SCL), 2017). Accordingly, the main purpose of the protocol was to determine the EOT and compensation for delay and disruption claim (Shahsavand, Marefat, & Parchamijalal, 2018). Moreover, it recommends the

management procedure for managing, predicting and determine the impact during execution of the project and focus to avoid disputes among parties (Keane & Caletka, 2015). Hence, the protocol provides information to prevent and resolve disputed that arise in the construction industry (SCL, 2017). Ultimately, SCL protocol provide guidance under 22 core principles about vague areas in delay and disruption claim management (Klee, 2018).

2.3. GUIDANCE ON CORE PRINCIPLES IN DELAY AND DISRUPTION PROTOCOL

According to Aibinu (2009), SCL protocol provide rules for assesing and quantifying claims regarding delay and disruption during pre-contract stage and post contract stage. Here, this protocol has clauses for reducing dispute costs, improving efficiency, and ensuring transparency and professionalism are considered to be benefits (Ward, 2011). Among the 22 core principles in the SCL protocol, the significant principles regarding claims management were elaborated below.

2.3.1. Programme and records

Disputes can be minimised to an extent using proper record keeping (SCL, 2017). SCL protocol suggests having an agreement for the type of records to be maintained (Keane & Caletka, 2015). Accordingly, records must be recorded contemporaneously and consistent with work progress (SCL, 2017). In order to establish the quality in record-keeping, contractor requires an investment of cost, time, and commitment of staff (SCL, 2017). Therefore, the contractor's obligation of record-keeping should be included in the tender and allow to price accurate for the requirement of records (SCL, 2017).

2.3.2. Contemporaneous analysis

According to SCL (2017), the time impact of ERE (Employer Responsible Event) should be dealt within a short time. Therefore, the EOT (Extension of Time) application should be submitted at the time the event occurs (Keane & Caletka, 2015). Further, the CA (Contract Administrator) should asses the EOT application within a reasonable time after the submission by the contractor (SCL, 2017). Ultimately, the protocol suggests that wait and see approach should be avoided because assessing the impact later would not be accurate (Keane & Caletka, 2015).

2.3.3. Float as it relates to time

Float is the criticality of an activity that can be delayed without affecting the overall completion date (Nagata, Manginelli, Lowe, & Trauner, 2018). However, exhausting the float would have some impact on the contract completion date (SCL, 2017). According to SCL, 2017, EOT should not be granted until the total float reduced to zero. As a result, there is a different argument on the ownership of float such as contractor owns the float, the employer owns the float and for the benefit of the project (Keane & Caletka, 2015). According to the contractor, the float was to give some relaxation and flexibility to carry out the work and it has been proposed during the planning (SCL, 2017). Conversely, the employer may argue that the delay event should affect the contract completion date unless the contractor has no entitlement to EOT (SCL, 2017). Therefore, the contract should address the ownership of float and the practical effects of permutation (SCL, 2017).

2.3.4. Concurrent delay

Concurrent delay is a vague area in claims management where most of the dispute arises (Baduge & Jayasena, 2012). According to Kikwasi (2013), both contractor and client are responsible for the concurrent delay. However, concurrency is used as a shield by both parties in defending delay claims (Baduge & Jayasena, 2012). As a result, the client will argue the contractor is responsible for the concurrent delay to avoid additional compensation, whereas, the contractors argue the client is responsible to avoid a claim for liquidated damages (Trauner, Manginelli, Lowe, Nagata, & Furniss, 2009). Here, the concurrent delay may have the occurrence on a similar critical path or may have on the separate path (Nagata et al., 2018). Ultimately, the contractor shall be entitled to EOT during the

concurrent delay for EREs (Keane & Caletka, 2015).The contractor has the entitlement to claim cost for events directly result from compensable delay (Keane & Caletka, 2015). However, the contractor is required to prove the additional cost has incurred from employer delay to completion and not from contractor delay to completion (SCL, 2017). Moreover, in a situation that those additional costs are not able to separate from non-compensable causes then the contractor is not entitled to an additional cost (Keane & Caletka, 2015).

2.3.5.Analysis time-distant from the delay event

Delay analysis is the calculation to determine the entitlement for compensation to either party in terms of the time and/or cost (Braimah, 2013). Thus, DAT must integrate the available information such as the dynamic nature of a construction schedule and critical path (Ennis, 2011). Currently, Impacted As-Planned, Time Impact Analysis, Collapsed As-Built, As-Planned vs. As-Built, and Global Impact Technique are used as DATs in Sri Lanka (Perera & Sudeha, 2013).

Impacted As-Planned is used to measure the impact of delay on the as-planned Critical path Method (CPM) schedule (Braimah, 2013). In order to measure the impact, delay analyst has to insert the delay events into the as-planned schedule (Nagata et al., 2018). Here, the difference between the completion dates in the as-planned CPM schedule before and after the impact will provide the total amount of delay (Baker, 2014). Time Impact Analysis is used to determine the effect of the delays on the updated as-planned schedule (Braimah, 2008). Rather than using the original as-planned baseline, this method uses multiple baselines for the analysis (Keane & Caletka, 2015), and each delay events are inserted one by one on the updated as-planned schedule (Braimah, 2008). Thereafter, the new completion date is identified as per the updated schedule during the delay period (Braimah, 2013). Here, the amount of delay caused is the difference between the new completion date and the date prior to the impact (Nagata et al., 2018).

Collapsed As-Built Analysis is based on the contractor's actual sequences and durations (Keane & Caletka, 2015). Accordingly, the analyst prepares a detailed as-built schedule based on the contemporaneous records (Nagata et al., 2018). After that, the EREs are extracted from the as-built program and hence, the delay impact on the project for the contractor is determined (AACEI, 2011). Moreover, the logical relation between the scheduled activities is also inserted in this method (Nagata et al., 2018). According to As-planned v As-build method, it first identifies the critical path in the as-planned programme and then, delays events are inserted into the as-built programme (Baker, 2014). Thereafter, the critical path in the as-built schedule is identified (Ekanayake & Perera, 2016). Here, the amount of delay is the difference between the completion dates of the as-planned schedule and as-built schedule (Braimah, 2013).

2.3.6. Mitigation of delay and mitigation of loss

The contractor has a general duty to mitigate the actual effects or potential losses due to ERE (Keane & Caletka, 2015). Accordingly, the contractor has to determine the appropriate mitigation measures to limit the impact of the delay event (SCL, 2017). However, the contractor is not supposed to assign extra resources or to work outside the planned working hours to mitigate the effects (Gibson, 2015). Conversely, if the employer insists the contractor to take measure then the employer should pay the incurred cost (SCL, 2017). Moreover, (SCL, 2017) highlighted that the contractor must take reasonable steps to minimise its loss and not to take unreasonable steps to increase its loss.

2.3.7. Acceleration

Contractor's progress may fall behind the planned programme due to many reasons (Keane & Caletka, 2015). In order, to complete the work in less time compared to the earlier plan, the contractor may accelerate the progress (Gibson, 2015). Here, acceleration directly links to the progress of a construction project to complete the original scope of work (Nagata et al., 2018). Accordingly, the cost of acceleration is the liability of the party responsible for the delay and/or party instructing to accelerate (Gibson, 2015). Moreover, the payment for acceleration should be agreed between the

parties prior to commencing the acceleration (Keane & Caletka, 2015). While the parties agreed for acceleration measures, the contractor is not an entitlement for prolongation (SCL, 2017).

2.3.8. Global claims

According to (SCL, 2017), it discourages the contractor's approach towards making the global claim without attempting to determine the cause and effect (SCL, 2017). Further, the protocol suggests that global claims can be avoided if the contractor has maintained accurate and complete records (SCL, 2017). Initially, quantify individually the claim for which the causal link can be established between the ERE and the resultant costs and/or loss claimed and then reminding claim for compensation can be claimed as a composite whole and here, the contractor need to establish the event for which this claim is made

2.3.9. Disruption claims

Disruption measuring techniques have been developed to analyze efficiency or to calculate the loss of productivity in construction projects (Keane & Caletka, 2015). Here, these techniques are used to prove the productivity loss or inefficiencies that were caused due to disruption event (Braimah, 2008). According to the SCL (2017), disruption measuring techniques can be categorized as productivity-based methods and cost-based methods here, productivity-based methods include project-specific studies, project-comparison studies, and industry studies. Project-specific studies are based on the people and records that are directly involved at the time of the disputed work (Nelson, 2011).

Measured mile analysis is used to compare the actual cost between the operations of the work in undisrupted periods with the same work affected by the alleged disruption (Ennis, 2011). At first, the labour productivity ratios during the non-impacted performance period to be calculated (Ennis, 2011). Earned value analysis is used to compare the number of man-hours required to complete the work as stated in the tender with the actual number of man-hours required to complete the particular work (SCL, 2017). Here, this method uses the three-dimension to measure the project performance such as budgeted cost of work schedule, budgeted cost of work performed and the actual cost of work performed (Braimah, 2008).

Programme analysis is based on the specialist software that tracks and allocate resources such as labour, cost, plant, and quantities over the project life (SCL, 2017). In detail, it is used to calculate both the periodic completion percentage and earned value for disrupted activities based on the provided information (SCL, 2017). Work or trade sampling method is used to determine productivity based on contemporaneous records that are obtained from direct observation of work (SCL, 2017). Accordingly, this method uses work sampling and craftsmen questionnaire sampling to estimate the loss of productivity (Nelson, 2011). System dynamic modelling is a comprehensive dynamic computer model that maps all relationships and feedback loops of the disrupted project (Nelson, 2011). Here, the cause and effect structure is developed to trace how the disruption occurred (Braimah, 2008).

Project-comparison studies can be used when the available records are insufficient to carry out the project-specific study (SCL, 2017). Undoubtedly, this method is a benchmark in deriving productivity factor to compare with the productivity achieved in the disrupted work (Ennis, 2011). Here, the productivity factor is determined from similar or equivalent projects where the disruption events are not occurred (SCL, 2017). Industry studies is a solution to determine loss of productivity where the contemporaneous records are insufficient to carry out the project-specific study or project-comparison studies (SCL, 2017). Here, the productivity rates that are recognized and accepted by the construction industry are used to compare with actual productivity observed during the alleged disrupted period (Ennis, 2011). Cost-based methods can be used to measure the loss of productivity only if the available contemporaneous records are insufficient to carry out the productivity-based approach (Nelson, 2011). Accordingly, this method measures the productivity as the difference between the actual cost and the contractual cost, here, the causal link between the reason for the loss of productivity and quantity of corresponding productivity loss is not considered (Braimah, 2008; SCL, 2017).

2.4. FEASIBILITY OF SCL PROTOCOL IN SRI LANKA

In addition, the implementation of SCL protocol would be beneficial for the proper delay and disruption claim management in Sri Lanka (Pathirana & Seneviratne, 2015). Guidance in SCL protocol are not contradict with FIDIC (Federation Internationale Des Ingenieurs-Conseils) and SBD (Standard Bidding Document) conditions which are commonly used as conditions of contract in Sri Lanka (Pathirana & Seneviratne, 2015). Therefore, guidance in this protocol can be used in harmony with the contract provision for the delay and disruption claim management in Sri Lanka (Jayasena & Alwis, 2011). Ultimately, majority of Sri Lankan professional accepted that SCL protocol would provide effective guidance (Pathirana & Seneviratne, 2015). However, most of the claim practitioners in Sri Lanka are not practicing SCL protocol (Pathirana & Seneviratne, 2015), due to unfamiliarity, lack of qualified professional, unawareness, government requirements, bureaucratic procedures, thinking attitudes of professionals, and employers are not interested to use SCL protocol (Pathirana & Seneviratne, 2015).

3. Research methodology

A comprehensive literature review was carried to gather knowledge about sustainable development during execution stage, disputes arising out of claims management, core principles in SCL protocol and the feasibility of SCL protocol in Sri Lanka. Significantly, the qualitative approach was implemented to have vast insight and perceptions of people's understanding about the research problem. Accordingly, the qualitative approach was designed with the expert interviews to explore the practicality of the SCL protocol for the Sri Lanka construction industry. Furthermore, the interviews were designed with the semi-structured interviews to give freedom of opinion of the experts. Particularly, the snowball sampling was used due to the difficulties in finding the claim specialist who have more than 10 years of experience in the claim management and hence, five experts were selected. Subsequently, the analysis was carried out with the code based content analysis using NVivo software.

4. Findings through expert interviews

4.1. CONTRADICTIONS IN SCL PRINCIPLES TO IMPLEMENT IN SRI LANKA

Expert interviewees highlighted the contradictory principles in the SCL protocol to use as guidance in Sri Lankan construction industry. Further, the interviewees have suggested the principles that suits Sri Lanka compared to core principles in the protocol. According to the above suggestions, the details were tabulated in the following Table 1.

Table 15: Contradiction in the SCL protocol to implement in Sri Lanka

Core principle in SCL protocol	***Suggested principle to Sri Lanka***
Float in the programme is for the benefit of the project and parties shall not take advantage of float	Contractor shall be allowed to reschedule the programme and shall reschedule without float
	CA has to consider the contractor's resource allocation, shall not expect same resource allocation throughout the project
Contractor can claim for additional cost caused by the employer delay can initiate to determine EOT in a situation the contractor	In business perspective, contractor to be paid for resources allocated to execute employer's work while the employer also have delayed
CA on his own fails to do so	FIDIC and SBD recommend, contractor have to initiate the claim. Here, with submission of notice CA cannot evaluate the claim
Contractor has to submit the programme and CA has to approve the programme, both party liable for programme	FIDIC and SBD recommend, CA shall give comments and not liable for the contractor's programme

4.2. CURRENT SRI LANKAN PRACTICES IN CLAIMS MANAGEMENT

Moreover, the interviewees have emphasized the current Sri Lankan practices in claim management that contradict with core principles in the protocol. Further, the interviewees have mentioned about

the consequences arising out of the current Sri Lankan practices. Ultimately, the following table 2 depict the Sri Lankan practices and consequences arising out of that.

Table 16: Current Sri Lankan practices in claims management

Current Sri Lankan Practice	*Consequences*
Contractor rarely submit the claim notice to the employer within reasonable time	Last minute submission of notice would cause financial barriers for the employer to settle all claims, because employer may have limited budget allocation for the project.
Contractor claim the compensation for delay at the end of the project based on the actual cost incurred for the extended contract period.	Difficulties for the contractor to collect the records to substantiate the claim, because the professionals who are responsible for record-keeping may not available at the end of project.
Contractor often submit global claim and fail to separate the cause and effects of each claims	Either party would not be satisfied on the compensation for global claim.
Contractor rarely update and submit the programme monthly	Contractor not follows the construction sequence so difficult to prove the progress

4.3. PRACTICAL DIFFICULTIES IN SRI LANKAN CLAIMS MANAGEMENT

In addition, interviewees have also identified the practical difficulties in claim management. Accordingly, the following table 4.3 was designed to elaborate the practical difficulties along with the reasons for the difficulties in claim management in Sri Lankan construction industry. Hence, these practical difficulties are the root cause for the above mentioned Sri Lankan practices in claim management explained in Table 2

Table 17: Practical difficulties in Sri Lankan claims management

Practical difficulties	*Reason for difficulties*
Limited quantity surveyors are employed in the site to carry out claim process and day to day site works	To win the competitive tender, contractor reduce overhead as a result limited number of staff employed
Contractor could not able maintain the planned labour resources during the execution of work	Contractor has no fixed labour resources throughout the project, obviously labour resource fluctuate
Contractor could not able to maintain the as-built programme by updating the programme daily based on actual work done	To win the competitive tender, contractor reduce overhead as a result limited the number of staff employed
Contractor could not able to manage activities in programme and update the programme in every monthly intervals	Activity duration in the programme may have more than 30 days due to contractor's method of construction

Significantly, most of the expert interviewees expressed the feasibility and practicality of the SCL protocol to Sri Lankan construction industry. Accordingly, the proper implementation of the protocol would help to enhance the Sri Lankan practices in claims management. Ultimately, it would minimize the disputes arising out of current Sri Lankan practice.

5. Conclusions

Sustainable development during the execution stage has considerable impact on the economic sustainability. Significantly, the sustainability during the execution stage can be achieved through good quality working relationship. On the other hand, the disputes arising in the construction industry have negative influence in the quality of working relationship. Here, the undefined areas of delay and disruption claims management in the condition of contract were the main cause of disputes. However, there are universal accepted guidelines to address the above mentioned undefined areas. Accordingly, the SCL protocol and Forensic Schedule Analysis were identified as notable guidelines in the construction industry. Subsequently, the SCL protocol is deemed as the best guideline for Sri Lankan claim management. Further, the analysis of expert interviews has suggested the modification to the

core principles to best suit the Sri Lankan construction industry. Even though the implementation has practical difficulties, the effective modification and implementation of SCL protocol together would enhance the collaborative working relationship among different professionals. Obviously, it would minimise the disputes in the construction industry. Ultimately, it prevent the project being overrun in terms of cost and time and also ensure the effective and efficient construction during the execution stage.

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COMPARATIVE STUDY ON ESTABLISHING LIFE CYCLE ASSESSMENT (LCA) IN BUILDINGS: DRIVERS

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Abstract
LCA is a method that systematically evaluates environmental impacts attributed to the building by quantifying environmental inputs and outputs over the lifecycle of buildings. LCA facilitates a sophisticated assessment procedure to promote eco-efficient designs to reduce environmental impacts. Although building-related LCAs are well-rooted in developed counties, it is challenging to disclose evidence of LCA application in Sri Lanka as a developing country. Therefore, this study aims to compare drivers that promote the application of LCA in developed countries and Sri Lanka to determine the deviation between two contexts. The qualitative research approach was adopted, and expert interviews were conducted with ten experts from Sri Lanka and nine LCA experts representing developed countries. The results indicated that 'identifying opportunities to improve environmental sustainability,' discovering energy-saving opportunities' etc. are the mostly identified drivers related to developed countries. In contrast, the mostly identified drivers in Sri Lanka were limited to two as 'growing industrial interest to build more green buildings' and 'as a new tool for R&D'. Initiation of strong government policies and effective incentive mechanisms, rising awareness on LCA, etc. identified as strategies to bridge the deviation between Sri Lanka from developed countries context in the implementation of LCA.

Keywords: *Buildings; Developed countries; Developing countries; Life Cycle Assessment (LCA), Sri Lanka*

1. Introduction

The built environment makes a substantial contribution to economic and social development in the modern world (Asif et al., 2007). Contrary, the building sector can be identified as one of the major sources for the environmental repercussions at local, national, and global levels as a consequence of erecting buildings and other forms of improvements (e.g., renovations, reconstructions, etc.) (Kylili et al., 2017). Moreover, building construction activities continue at a fast pace. Thus, society is running under heavy pressure due to the generation of grave ecological issues such as global warming, climate change, natural resource depletion, and waste accumulation (Baccarne et al., 2016). Consequently, there is an imperative need to mitigate these environmental challenges arisen with the escalation of building construction activities (Cabeza et al., 2014). Subsequently, several methods have implemented to address environmental problems. Examples include LCA, Environmental Auditing, Ecological Footprint Calculation, Environmental Impact Assessment (EIA), and so on (Atmaca, 2016; Todd, 2012).

Amongst, tools mentioned above, LCA is an analytical method that systematically investigates the potential environmental impacts attributed to the building by quantifying material usage, energy consumption and environmental releases (i.e., atmospheric emissions, solid waste generation, and waterborne waste) over the lifecycle. LCA enables the quantification of cumulative environmental impacts attached along the entire lifecycle from “cradle to cradle” (Silvestre, et al., 2014). The term “cradle to cradle” refers to the interlinked phases in the entire lifecycle from raw material extraction to disposal.

LCA is recognized as a robust decision-making tool to identify opportunities for environmental improvements (Chau et al., 2015). For instance, Ding (2014) emphasized that LCA has been utilized to promote eco-efficient designs to reduce environmental impacts in the built environment. On the other hand, LCA has been mostly applied in buildings in developed countries such as; Europe, North America, Japan, and Korea (Saunders, et al., 2013). For instance, LCA study was carried out on residential buildings in the United Kingdom (UK), which analyzed the environmental impacts throughout the whole lifecycle. The results disclosed that amongst different lifecycle stages, the operation stage is the major contributor to most environmental impacts (Lawania and Biswas, 2017). However, the application of LCA in the building sector of developing countries is limited (Saunders, et al., 2013).

When considering Sri Lanka as a developing country, the building constructions would be projected to boom in the coming years with the forthcoming construction projects (Fernando, 2016). With the rapid increase of buildings, Sri Lanka has been facing several different environmental challenges (e.g., pollution, construction waste generation, etc.) (Munasinghe et al., 2017). It has appeared as a need to integrate the concept of LCA for buildings in Sri Lanka to mitigate the increasing environmental impact. Though LCA had well-rooted internationally, it is challenging to disclose evidence on the LCA application in the Sri Lankan building sector. Therefore, this study aims to conduct an in-depth investigation and compression of the driving factors that promote the application of LCA in developed countries and Sri Lanka to determine the deviation of Sri Lanka from the developed countries. Finally, this study provides strategies to bridge the gap between developed countries and Sri Lanka.

2. Literature Review

2.1. DRIVERS IN IMPLEMENTING LCA OF BUILDINGS

Drivers are the factors that encourage the implementation of the LCA. LCA results could be used to compare the environmental impacts of alternative building materials, to select materials with least environmental impacts (Ortiz-Rodríguez et al., 2010). LCA considers a wide range of environmental impacts categories such as global warming, resource depletion, water depletion, eutrophication, ozone depletion, acidification, eco-toxicity, and so forth (Rebitzer, et al., 2004). Hence, Kutnar and Hill (2015) stated that one of the valuable outcomes of the LCA study is to recognize the 'hot-spots', which are the most significant environmental issues in the lifecycle, where the improvements could be made to get the greatest environmental benefits. Therefore the incorporation of LCA to the early design stage of construction would support in making environmentally-conscious decisions with proper scientific justification. Accordingly, LCA is generally recognized as a decision-making tool to identify opportunities for environmental improvements, which drives the application of LCA to the buildings.

Moreover, Dewulf et al (2009) emphasized that the buildings in developed countries actively contributes to publishing handbooks and organizing workshops on LCA, which could also be recognized as drivers in implementing LCA. There is also a growing interest in constructing green buildings in developed countries to achieve environmental sustainability targets. The construction of green buildings involves a full LCA to evaluate the harmful effects on the environment throughout the entire lifecycle of the building. Consequently, the growing interest in the development of green buildings acts as a strong driver for the adoption of LCA in the building industry in developed countries (Singh et al., 2011). Moreover, Asadollahfardi et al (2015) specify that LCA software applications have introduced in recent times that make it easy to implement LCA buildings. Likewise, many studies have divulged various drivers that encourage the implementation of LCA for buildings. The summary of the literature findings of the drivers is tabulated in Table 1 with relevant references.

Table 1: Drivers for LCA implantation to the building sector

No	Drivers	Ref. Code
1	To recognize opportunities to improve environmental sustainability	2,4
2	To introduce environmental targets and benchmarks for buildings	4
3	To discover energy-saving opportunities	2, 3
4	Growing industrial interest to erect more green buildings	1, 2
5	Top management pressure for LCA implementation	1
6	To meet eco-labeling requirements	1, 2, 3, 4
7	As a novel tool for Research and Development (R&D)	1
8	As an environmental law or political pressure	1, 3
9	Due to the LCA application from other competing companies	1
10	Growing industrial interest in applying LCA for the built environment	1
11	To obtain marketing benefits	4

Source: (Adapted from 1- Frankl and Rubik, 2000; 2- Lewis and Demmers, 1996; 3- McManus and Taylor, 2018; 4- Bribián et al., 2009)

3. Research Method

Lichtman (2010) highlighted that qualitative research methodology uses to capture a deeper understanding of particular problem domains by investigating experts' knowledge and experiences. Qualitative research involves collecting and analyzing non-numerical data to understand concepts, opinions, or experiences. Furthermore, as stated by Lapan et al (2012), a qualitative research method could be utilized to conduct in-depth research using a small sample size. LCA applications in the building sector not popular in Sri Lanka yet. Hence, only a very few LCA experts have found both practical exposure and knowledge in Sri Lanka. To exploring this novel phenomenon of the LCA concept, the qualitative approach could be identified as the most appropriate method by exploring LCA experts' knowledge. Moreover, this research focuses on investigating the driving factors that promote the application of LCA in developed countries and Sri Lanka to determine the strategies to establish LCA in the Sri Lankan building sector, which generates a high volume of qualitative data. Semi-structured expert interviews were carried out with the help of a snowball sampling technique. Moreover, expert interviews comprise ten (10) Sri Lankan LCA experts and nine (9) experts representing developed countries (Canada, , UK United States of America (USA), and Australia), and outcomes were analyzed using content analysis to develop the findings and conclusions. The profile of the interviewees is shown in Table 2.

Table 2: Profile of the Interviewees

Type of Interviewees	Designation	Reference Code	LCA Experience
Interviewees from Sri Lankan	General Manager –Sustainability	SL1	11 years
	Senior Lecturer	SL2	10 years
	Manager- Sustainability Assurance	SL3	8 years
	Director –Sustainability	SL4	17 years
	Chief Executive Officer	SL5	12 years
	Chief Executive Officer	SL6	14 years
	Engineer	SL7	5 years
	Senior Lecturer	SL8	14 years
	Professor -Environmental Science	SL9	5 years
	Consultant –Sustainability	SL10	6 years
Interviewees from Developed Countries	Professor -Sustainable Construction	DC1	17 years
	Senior Lecturer	DC2	10 years
	Researcher - LCA	DC3	4 years
	Researcher - LCA	DC4	3 years
	Engineer	DC5	19 years
	Professor -Environmental Management	DC6	14 years
	Engineer	DC7	17 years
	Researcher	DC8	5 years
	Professor	DC9	16 years

4. Data Analysis and Research Findings

4.1 DRIVERS IN IMPLEMENTING LCA OF BUILDINGS IN DEVELOPED COUNTRIES

Driving factors which motivate the adoption of LCA in developed countries were critically reviewed, to integrate those practices to the Sri Lankan buildings and to inspire the Sri Lankan building sector to adopt LCA. Respondents representing the developed countries were presented with identified drivers (see Table 1) from the literature synthesis and were asked to identify drivers applicable to developed countries with the help of their knowledge and experience.

From the expert interview findings, it was revealed that drivers such as 'recognize opportunities to improve the environmental sustainability, 'discover energy-saving opportunities', 'growing industrial interest to erect more green buildings', 'to meet eco-labeling requirements', 'growing industrial interest on applying LCA for the built environment' and 'to obtain marketing benefits' are the drivers

which have been agreed by all respondents. DC2 stated that "*LCA has been used to improve environmental performances by identifying ecological hotspots throughout the building lifespan due to the global movement towards achieving a more sustainable environment*". Besides, interview findings highlighted that LCA has been driven to the buildings as an environmental communication tool to attract green-conscious clients.

It has been disclosed that the drivers such as 'due to the LCA application from other competing companies' and 'to acquire subsidies on environmental impact reduction' could be identified as drivers that are reported by eight out of nine respondents. DC4 emphasized, "*provision of low-interest loans and tax benefits for environmental friendly constructions drives the LCA implementation into the Canadian buildings*." It appears that government incentives increase the willingness to conduct LCA of buildings. The driving factor of 'introduce environmental targets and benchmarks for buildings' is another driver reported by seven out of nine respondents.

Additionally, a very limited number of respondents identified 'top management pressure' as a driver for implanting LCA of buildings. Only two out of nine respondents have mentioned "as a novel instrument for R&D' as a driver. LCA is no more a novel instrument for Canada, UK, and the USA. The driver of 'as environmental law or political pressure' does not apply to the developed countries, as it was not mentioned by any of the respondents. LCA is a voluntary approach utilized by practitioners to make accurate decisions rather than an adapted approach due to regulatory or political pressure.

In addition to the drivers identified from the literature review, interviewees mentioned new drivers such as, 'awareness of the general public on LCA concept', 'preparation of maintenance, retrofitting, carbon-neutral and rehabilitation tools by using LCA data', ' to improve recognition', 'empirically proved benefits of conducting LCA' and 'due to the introduction of Simplified LCA method', which applies to the developed countries.

4.2 DRIVERS IN IMPLEMENTING LCA OF BUILDINGS IN SRI LANKA

It is very critical to understand the drivers, which encourage LCA application in Sri Lanka to enhance the existing level of application furthermore. Thenrespondents representing Sri Lanka were presented with identified drivers (see Table 1) from the literature synthesis and were asked to identify drivers applicable to Sri Lanka with the help of their knowledge and experience.

From interview findings, it was vivid that drivers such as 'growing industrial interest to erect more green buildings' and 'as a novel tool for R&D', identified by all interviewees. Furthermore, SL1 mentioned that "*the rapid increase of buildings, brought pressure on environmental protection and resource conservation in Sri Lanka. Subsequently, there is a rising interest in developing green buildings. Green building constructions require an integrated building LCA, which considers all environmental impacts throughout the entire building lifecycle. Also, the integration of LCA with the LEED certification process provides a strong foundation for the adoption of LCA of buildings"* As per the views of SL9, "*there is a trend in applying LCA as a novel instrument for eco-innovation, which drives LCA of buildings. Research activities on LCA are also increasing among the researchers to support eco-innovations in Sri Lanka.*"

It was discovered that the drivers such as 'to recognize opportunities to improve the environmental sustainability', 'to meet eco-labeling requirements' and 'discover energy-saving opportunities' remain as critical drivers to its adoption in Sri Lanka. Supportively SL5 elaborated that "*LCA results could be used to compare the environmental impacts of alternative materials that could be used during the building construction process. Hence, LCA is driven to the buildings by integrating proactive environmental concerns.*" In addition to the above, interviewees stated that the building sector had

been criticized as one of the highest energy-consuming sectors. Hence LCA drives to recognize energy -saving opportunities through energy reductions during the entire lifecycle.

As per the opinion of six experts out of ten, 'growing industrial interest on applying LCA for the built environment' and 'to obtain marketing benefits' are perceived to have some degree of importance for implementing LCA. Besides, the driving factor of 'due to the LCA application from other competing companies' was the factor which was rarely highlighted by the experts. Conversely, drivers such as 'top management pressure', 'as environmental law or political pressure', and 'acquire subsidies on environmental impact reduction' do not apply to the Sri Lankan context, as none of the interviewees agreed for these as drivers. According to SL3, "*top management and political pressure cannot be seen within the Sri Lankan building sector due to the lack of awareness of LCA*." SL6 emphasized that "*lack of advocatory incentives play a main role in the Sri Lankan building sector to hinder the adoption of LCA*."

Additionally, 'Sustainable Public Procurement (SPP) for building products', 'ISO 14001 certification', 'National Green Reporting System of Sri Lanka' could be identified as new drivers, which were added by the interviewees in addition to the literature findings.

4.3 COMPARISON BETWEEN DRIVERS IN IMPLEMENTING LCA OF BUILDINGS IN DEVELOPED COUNTRIES AND SRI LANKA

Section 4.1 and section 4.2 respectively discuss the interview findings on drivers on the implementation of LCA for developed countries and Sri Lanka. This section addresses the similarities and dissimilarities between the two contexts mentioned above to determine the deviation of Sri Lanka from the developed countries.

When considering the similarities between the two contexts, it could be identified that drivers such as 'to recognize opportunities to improve the environmental sustainability', discover energy-saving opportunities, 'growing industrial interest to erect more green buildings' and 'to meet eco-labeling requirements' common for both contexts. All experts in the mindset that the aforesaid factors become drivers for both contexts. Nevertheless, when it comes to the Sri Lankan context, LCA has been driven to the buildings by focusing on calculating the global warming potential of the building lifecycle. However, in developed countries, LCA has been focused on multiple impact categories such as global warming, acidification, eutrophication, ozone depletion, etc. rather than one impact category.

The driver of 'top management pressure to implement LCA' and 'as environmental law or political pressure' cannot be identified as drivers for both contexts. According to DC6 "*government regulations and policies are making the enabling environment by directing towards "life-cycle accountability;" building owner is responsible for direct construction impacts, as well as for the indirect impacts related to material usage, transportation, and disposal. Stakeholders in building and construction are applying LCA as a voluntary practice to represent the contribution and strong efforts to construct sustainable buildings other than due to environmental or political pressure*." Further, it was confirmed by SL3 mentioning, "LCA cannot be regulated, it has to be done voluntarily."

Dissimilarities also could be found between the two contexts. LCA has been driven to the Sri Lankan buildings as a novel instrument for R&D, contrary when it comes to the UK, USA, and Canadian, LCA is not a novel instrument. In the developed countries, the driver of 'due to the LCA application from other competing companies' is highly voted. Nevertheless, it has not become a highly voted driver for Sri Lanka. According to SL2, "*awareness on LCA is relatively low and demand for LCA is not derived from the building sector. The life cycle concept is not yet being considered when designing buildings in Sri Lanka*." Hence, the driving factor of 'growing industrial interest on applying LCA for the built environment' is not a highly voted driver in Sri Lanka, even though it has been highlighted as one of

the highly voted drivers in developed countries. 'To obtain marketing benefits' and 'to acquire subsidies on environmental impact reduction' not become drivers to implement LCA of buildings in Sri Lanka. Nevertheless, these were identified as drivers in developed countries.

4.4 STRATEGIES TO ENHANCE THE LCA APPLICATIONS IN SRI LANKA
This section presents appropriate strategies to enhance the LCA application in Sri Lanka.

- **Initiation of strong governmental regulations and effective incentive mechanisms**

SL2 stated that " *it is more critical to implement country-level emission reduction objectives and energy-saving goals for the buildings through the introduction of building regulations, acts, policies, codes, and standards with the use of LCA*." Interviewees highlighted that the government could provide rewards and incentives to encourage sustainability initiatives within the Sri Lankan building sector. Incentives in the sort of, insurance premium reductions, tax reductions, green loans as well as rewards can be awarded to appraise the adoption of sustainable and green building practices. With the encouragement of sustainability initiatives, it will automatically increase the LCA practice within the building industry.

- **Rising awareness**

LCA of buildings in Sri Lanka is evolving and still immature. Stakeholders in the Sri Lankan building sector are unaware of the potential financial and non-financial benefits of applying LCA. Hence, rising stakeholders' awareness is an effective way of popularizing and promoting the LCA within the Sri Lankan building sector, as it may help to convert stakeholders' attitudes into demand conditions. SL2 and DC8 emphasized that it is essential to make construction professionals, investors, and clients aware of LCA by conducting awareness-raising programs. Supportively, SL9 highlighted that "*the LCA concept needs to promote within the building sector by emphasizing its benefits, then it will be automatically applied within the industry*."

- **Encourage to conduct LCA based research activities**

Professionals in the field of the building sector are not interested in research activities on LCA. Therefore, SL9 mentioned that it is important to prioritize research activities by providing funding for LCA-based research. Consequently, researchers could then share evidence-based, accurate information with industry professionals. This will result in a higher level of LCA applications in the future than in the current situation. SL8 supported by stating, "*universities in collaborating with the government should allocate sufficient grants for research activities*."

- **Integrate LCA concept with undergraduate and postgraduate curriculum**

As per the views of SL5, SL6, and DC9 it is necessary to integrate LCA with undergraduate and postgraduate curriculums to popularize LCA among future professionals. As a result of that, the LCA concept automatically receives a prominent place in the building sector.

- **Development of regional specific LCA databases**

The availability of LCA software and databases could be identified as one of the most important requirements for enhancing the application of LCA by proving LCA data to ensure successful application in the building sector. Therefore, SL 3 sated that action needs to be taken to develop a user-friendly LCA database.

Above identified strategies could be utilized to enhance the LCA application in the Sri Lankan construction industry

5. Conclusions

The findings of the study revealed that LCA is a well-established concept in developed countries, although it has not yet penetrated to the Sri Lankan building sector. Hence, drivers in implementing LCA in developed countries were compared with Sri Lanka to determine the deviation of Sri Lanka

from the developed countries. Drivers such as 'recognize opportunities to improve the environmental sustainability, 'discover energy-saving opportunities', 'growing industrial interest to erect more green buildings', 'to meet eco-labeling requirements', 'growing industrial interest on applying LCA for the built environment' and 'to obtain marketing benefits' were the most identified driving factors related to the context of developed countries. In contrast to that, only two drivers, such as 'growing industrial interest to erect more green buildings' and 'as a novel tool for R&D" were the most identified in the Sri Lankan context. Moreover, LCA has been driven to the Sri Lankan buildings as a novel instrument for R&D, but for the UK, USA, and Canadian context, LCA is not a novel instrument. Further, the drivers of 'top management pressure to implement LCA' and 'as environmental law or political pressure' cannot be identified as drivers for both contexts.Furthermore, it could be mentioned that 'recognize opportunities to improve the environmental sustainability, 'growing industrial interest to erect more green buildings', 'to meet eco-labeling requirements', 'growing industrial interest on applying LCA for the built environment' and 'to obtain marketing benefits' were become drivers to the developed countries which were identified by all respondents due to the well establishment of LCA of buildings. However, those are not drivers in Sri Lanka since it is in the inception stage of applying LCA of buildings. Initiation of strong government policies and effective incentive mechanisms, rising awareness on LCA, sponsoring to perform more LCA related research activities, and combine LCA into undergraduate and postgraduate curriculums could be identified as strategies used to bridge the deviation between developed countries context from Sri Lanka context in the implementation of LCA. Recognized strategies can be used to extend the application of LCA by gaining benefits for the Sri Lankan building sector. The scope of the research was narrowed to compare the LCA of buildings in developed countries and Sri Lanka and developing countries (i.e. Sri Lanka) predominantly represented the perception of professionals whereas developed countries predominantly represented the perception of academics. This might be due to the difficulties in sampling.

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MANAGEMENT OF VARIATIONS WITH THE USE OF STANDARD FORMS OF CONTRACT IN PUBLIC SEcTOR BUILDING PROJECTS IN SRI LANKA

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Abstract
In most of the public construction projects in developing countries, a large number of 'variations' that result from the changes made to the original scopes of the projects urge the need of variation management by the parties to a contract. This study explores the ways of managing variations in public sector building projects executed in Sri Lanka with the use of Standard Forms of Contract. It applied a qualitative research approach and used a comprehensive literature review expert interviews for data collection. Manual content analysis was used to analyse the collected data. The findings reveal numerous causes of variations for which the Employer, Consultant, Contractor, or certain other factors are responsible. The research also reveals that the variations could be minimised by adopting strategies, such as the preparation of a fully detailed Employer's brief, review of the design and deployment of qualified personnel. The study proposes to modify the variation clause by adding more explanations in the Standard Form of Contract to facilitate effective variation management in Sri Lanka.

Keywords: *Causes of Variation; Forms of Contract; Management Strategies; Public Sector Building; Variations.*

1. Introduction

The construction industry in a developing country is a major contributor to the economic growth of the country, which makes use of human and physical resources while improving the economic efficiency of its processes (De Valence, 2019). The industry can afford to maintain strong links with other industries because of its large and responsive nature (Durdyev and Ismail, 2017). Hence, the contribution of the construction industry to the country's economic growth and national development is highly acknowledged, especially in developing countries (Niazi and Painting, 2017). However, changes or variations in contracts are common in modern construction projects (Onkar and Bhirud, 2015). These constant variations have an adverse impact on the public sector building projects in developing countries leading to time and cost overruns, work disruptions, conflicts and disputes. Moreover, causes of variations depend on the country, while in a particular country they depend on the sector and its associated development activities (Mhando et al., 2018).

Sri Lanka is a developing country, where the state sector plays a key role in the construction industry supported by the private sector (De Valence, 2019). Central Bank of Sri Lanka (CBSL) (2020) reported that the construction industry has contributed 6.9% to the national Gross Domestic Product (GDP) in 2019. The construction cost of projects has increased progressively over the past decade because of increased demand, increased cost of labour and building materials (Ministry of Finance, 2017), and in particular, due to the variations occur in construction projects (Abidemi et al., 2018). Gunarathna et al. (2018) revealed that a majority of variations in construction projects in Sri Lanka occurs because of the changes made to the initial design by the Employer and the Engineer leading to conflicts in terms of time, cost and quality. Most of the government construction projects in Sri Lanka have many variations, which results in claims and disputes (Jayawardena, 2014). The majority of the claims arise from time and cost overruns; and other deficiencies in the contract (Niazi and Painting, 2017). Therefore, managing variations related costs has been a major concern in the construction industry in Sri Lanka.

In Sri Lanka, the Construction Industry Development Authority (CIDA) has published a series of Standard Bidding Documents (SBD), called 'Forms of Contracts', for the procurement of works in contracts executed in the country. They offer a range of contractual provisions that can be used to manage variations in construction projects. Previous studies focused on variation management in the construction industry in Sri Lanka have not discussed the provisions in the Standard Form of Contract for managing the variations in public sector building projects by the parties to a contract. This study,

therefore, explores the ways of managing variations in public sector building projects in Sri Lanka by the parties to a contract by focusing on provisions in the CIDA Standard Forms of Contract. The study initially focuses on identifying causes of variations and the deficiencies of variation clause in CIDA Standard Forms of Contract. Thereafter, the study proceeds to investigate the strategies that will overcome the impact of the variations.

2. Literature Review

2.1. VARIATIONS IN CONSTRUCTION PROJECTS

The term 'variation' refers to any type of deviation from the defined scope or schedule in the initial contract (Keane et al., 2010). According to CIDA/SBD/02 (2007), a variation may include changes to the quantities, quality, levels, positions and/or dimensions, omission or addition of any work and changes made to the sequence or timing of the execution of the Works. Since it is rarely possible to complete a project without making changes to the initial scope of works, variations have become common in construction (Sunday, 2010).

2.2. CAUSES OF VARIATIONS

Many causes of variations have been identified by researchers, and most of those researchers have related the causes to construction project factors such as time, cost and quality, and project stakeholders (Bello and Saka 2017). Abidemi et al. (2018), Jayawardena et al. (2014), Halwatura and Ranasinghe (2013), and Keane et al. (2010) have discussed the causes of variations under four categories: Employer-related variations, Consultant-related variations, Contractor-related variations and other causes, which are beyond the control of the parties. This study used these same categories to explore the causes of variations in public sector construction projects executed in Sri Lanka. 'Changes made to the plans or scope' by the Employer and the 'inadequate project objectives' are prominent causes among the Employer-related causes of variations (Abidemi et al., 2018). The most significant Consultant-related cause identified by Abidemi et al. (2018) and Alaryan et al. (2014) is 'inadequate working drawing details'. According to Mhando et al. (2018) and Onkar and Bhirud (2015), 'design discrepancies' is significant in the public sector building projects in developing countries. 'Differing site conditions' is the most prominent cause of Contractor-related variations in public sector construction projects in developing countries (Sunday, 2010, Jayawardena et al., 2014). 'Weather conditions' highly contribute to variations in developing countries (Jayawardena et al., 2014; and Abidemi et al., 2018). However, Onkar and Bhirud (2015) mentioned that 'weather conditions' and 'unforeseen problems' are equally important other causes of variations in construction projects.

2.3. MANAGEMENT OF VARIATIONS

Variation management in construction contracts involves identifying, initiating, instructing, approving, and valuing variations (Ministry of Finance, 2017). According to Arain and Pheng (2005), the construction process can get affected by variations and unpredictable factors depending on the performance of the parties to the contract, availability of resources, environmental conditions, the involvement of other stakeholders and contractual relations. The authors further explain that if project team members have proficient knowledge and previous experience in similar projects, proper planning could be facilitated throughout the design and construction phases to minimise and control variations and their consequences. Table 1 presents the strategies that will help to manage variations that were identified by past researchers and by the expert interviewees.

2.4. STANDARD FORMS OF CONTRACT

The Standard Forms of Contract set out the basic procedures and rules for managing variations (Singh, 2002). In commercial contracts, there has to be a provision to make changes to a contract in writing signed by or on behalf of both parties to the contract (Halwatura and Ranasinghe, 2013). The

National Procurement Agency (NPA), Sri Lanka (2007) recommends procuring entities to use the series Standard Bidding Documents (SBDs) published by Construction Industry Development Authority (CIDA) as Forms of Contract with minimum changes made to the general provisions, where necessary. The CIDA/SBD/02 (for major contracts) stipulated a few clauses as provision for variations that encompass how to initiate variation by the Engineer, the Contractor's obligations, what constitutes a variation, the process of value engineering, management of provisional sum and dealing with minor or incidental works in the contract.

2.5. THE NEED FOR MANAGEMENT OF VARIATIONS

Undoubtedly, managing variations is one of the most critical factors in building projects that lead directly to the successful project completion. The significant increase in labour and material prices together with the increased demand that exists for construction has increased the costs of building projects in Sri Lanka (Ministry of Finance, 2017). These causes are common in public sector building projects in developing countries (Onkar, 2015; Abidemi et al., 2018). Mhando (2018) states that a large number of variations found in these projects affect the cost and construction programmes of the projects. Arain and Pheng (2005) explained that disputes in contracts arise because of the shortcomings in the contractual provisions in the contracts. According to the Ministry of Finance (2017), variations have to be properly managed using the provisions in the conditions of contract. The rights and obligations of each party to the contract have to be properly defined in the contract to ensure a fair distribution of risks among the parties concerned. Thus, to enhance the variations management in government building projects in Sri Lanka, it is necessary to be aware of their causes to realise the impact towards project execution and the strategies that can be adopted to manage these variations.

3. Methodology

The research question of the study was 'How to manage the variations in public sector building projects in Sri Lanka?'. Thus, a comprehensive literature review was first done followed by expert opinion survey to collect the empirical data through qualitative means. Seventeen experts, who were well conversant with managing variations in construction projects and with more than 15 years of experience in such projects were selected using non-probability purposive sampling. The expert interviews were conducted to check initially, the validity of the literature findings on causes of variations and strategies to manage variations. Subsequently, interviewees were encouraged to present their viewpoints on causes of variations, modifications to CIDA Standard Forms of Contract and strategies to manage variations in the public sector building projects in Sri Lanka. The collected data were analysed using manual content analysis, which is appropriate for analysing qualitative data (Kumar, 2011).

4. Findings and Analysis

4.1. CAUSES OF VARIATIONS IN PUBLIC SECTOR BUILDING PROJECTS IN SRI LANKA

The interviewees were asked to comment on the causes of variations in public sector building projects that were identified from the literature and present any other causes of variations they have encountered while working in Sri Lanka (Table 1). The highlighted causes in Table 1 are the new causes identified by the interviewees as specific to Sri Lanka. All the respondents accepted, 'changes made to the plans or scope' and 'inadequate project objectives' as Employer-related causes of variations in construction projects in Sri Lanka.

Table 1. Causes of variations in public sector building projects in Sri Lanka

Causes	I-1	I-2	I-3	I-4	I-5	I-6	I-7	I-8	I-9	I-	I-	I-	I-	I-	I-	I-	I-
Employer-related Causes																	
Changes made to plans or scope	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Inadequate project objectives	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Replacement of materials or procedures	√	√	√	√	√	√	√	-	√	√	√	√	√	√	√	√	√
Impediments to prompt decision-making	√	√	√	-	-	√	-	√	√	-	√	√	√	-	√	√	√
Obstinate nature of the Employer	-	-	-	√	-	√	√	√	√	√	√	√	√	√	-	√	√
Changes made to the schedule	-	-	-	√	√	√	-	√	√	√	√	√	√	-	√	-	√
Financial problems of the Employer	√	-	√	-	-	√	-	-	-	√	-	-	√	√	√	-	√
Changing of the Employer	-	-	√	-	√	-	-	-	-	-	-	-	-	-	-	-	√
Changes made to the Employer's requirements	-	-	√	√	√	-	-	-	-	-	-	-	-	-	-	-	-
Changing of the land/ location	-	-	√	-	√	-	-	-	-	√	-	-	-	-	-	-	-
Absence of financial arrangements	-	-	-	-	-	√	-	-	-	√	-	-	-	-	-	-	-
Differences in business strategies	-	-	-	-	-	-	-	-	-	-	-	-	√	-	-	-	-
Consultant-related Causes																	
Inadequate working drawing details	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Design discrepancies	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Errors and omissions in the designs	√	√	√	√	√	√	-	√	√	√	√	√	√	√	√	√	√
Changes made to the design/ specifications	√	√	√	√	√	√	-	√	√	√	√	√	√	√	√	√	√
Unavailability of the required data	√	-	√	√	-	√	√	√	√	√	√	-	√	√	√	√	√
Incompatibilities among contract documents	√	-	√	√	-	√	-	√	√	√	√	-	√	√	√	√	√
Lack of coordination	-	-	-	√	-	√	√	√	√	√	√	√	√	√	√	√	√
Lack of judgment and experience	-	-	-	√	-	√	√	√	√	√	√	√	√	√	√	√	√
Lack of knowledge on the material availability	-	-	-	√	√	√	-	√	√	√	√	√	√	√	√	√	√
Inadequate scope of work given for Contractor	√	-	√	√	√	√	-	√	-	-	-	-	-	√	√	√	√
Inadequate investigations	-	-	-	-	-	-	√	√	-	-	-	-	-	-	√	-	√
Inadequate design periods	-	-	-	-	-	-	√	√	-	-	-	-	-	-	√	-	√
Design developments	√	-	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Contractor-related Causes																	
Differing site conditions	√	√	√	-	-	√	√	√	√	-	√	√	-	√	√	-	√
Misinterpretation of contract documents	-	√	-	-	-	√	-	-	√	√	-	-	√	√	√	-	√
Lack of strategic planning	-	-	-	-	-	-	-	-	√	√	-	-	√	√	√	-	√
Unavailability of materials and equipment	-	-	-	-	-	-	-	-	√	√	-	-	-	√	√	√	√
Lack of communication	-	-	-	-	-	-	-	-	√	√	-	-	√	√	√	-	√
Shortage of skilled manpower	-	-	-	-	-	-	-	-	√	-	-	-	√	√	√	-	√
Defective workmanship	-	√	-	-	-	-	-	-	-	-	-	-	√	-	√	√	√
Financial difficulties	-	-	-	-	-	-	-	-	-	-	-	-	√	√	-	√	√
Weak procurement process	-	√	-	-	-	-	-	-	√	-	-	-	-	-	-	√	√
Value engineering options	√	-	√	-	-	-	-	-	-	-	-	√	-	-	-	-	√
Other Causes																	
Changes in government regulations	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Unforeseen problems	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Unavailability of construction materials and equipment due to closure and siege	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Internal political problems	√	√	√	√	-	√	√	√	√	√	√	√	√	-	√	√	√
Change in economic conditions	√	√	√	√	-	√	-	√	√	√	√	√	√	-	-	√	√
Socio-cultural factors	√	√	√	√	-	√	√	√	√	√	√	√	-	-	√	-	√
Safety considerations	√	√	√	√	-	√	√	√	√	√	√	√	-	-	√	-	√
Weather conditions	-	√	-	√	-	√	-	√	-	√	√	√	-	√	√	√	√
Public objections and issues related to environmental clearance	-	-	-	-	-	-	-	-	-	√	√	-	-	-	-	-	-
End-user requirements	-	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Moreover, 'Changing of the Employer' and 'changes made to the Employer's requirements' were highlighted through expert interview survey as the two most significant Employer-related causes of variations specific to the public sector building projects in Sri Lanka. 'Inadequate working drawing details' and 'design discrepancies' are the two most prominent Consultant-related causes as

conformed by the interviewees, whereas 'inadequate investigations' and 'inadequate design periods' were the two most significant Consultant-related causes specific to Sri Lankan public sector building projects. Even though the Contractor does not contribute to variations, differing site conditions could be a cause of variations during the construction phase, as confirmed in literature and through the expert survey. Besides, the interviewees argued, value engineering options may cause variations in Sri Lanka due to lack of knowledge and experience in implementing such methods in the local context. 'Changes in government regulations', 'unforeseen problems', and 'unavailability of construction materials and equipment due to closure and siege' were the other causes confirmed by all the interviewees as the causes related to public sector building projects in Sri Lanka. Furthermore, 'public objections and issues related to environmental clearance' were found to be a major causes of variations in Sri Lanka, which is beyond the control of the parties to the contract.

4.2. MANAGEMENT OF VARIATIONS BY THE PARTIES TO THE CONTRACT

The interviewees were also requested to verify the strategies to address the causes of variations that were identified from the literature, are applicable in Sri Lanka and to propose any new strategies that would avoid or minimise the causes of variations in public sector building projects in Sri Lanka (Table 2). The strategies that are applicable specifically in Sri Lanka and, which are not mentioned in the literature are highlighted in Table 2. All of the interviewees confirmed that the Employer has to 'provide a fully detailed Employer's brief' that was recognised from the literature and 'define project objectives clearly at the inception stage' to minimise variations, as a specific strategy to the Sri Lankan context.

Table 2. Strategies to manage variations in public sector building projects in Sri Lanka

Proposed Strategies	I-1	I-2	I-3	I-4	I-5	I-6	I-7	I-8	I-9	I-10	I-11	I-12	I-13	I-14	I-15	I-16	I-17
Strategies to manage variations by the Employer																	
Provide a fully detailed Employers' brief	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Deploy in advance suitably qualified personnel									√	√							
Adopt standardisation of materials and documents	√	√	√	√	√	√	√		√	√	√	√	√	√	√	√	√
Establish realistic time frames				√	√	√		√	√	√	√	√	√		√		√
Assess probable risks through initial investigations									√	√							
Settle all land-related issues as early as possible	√		√							√							
Arrange to fund according to realistic budget plans	√		√			√				√			√	√	√		√
Appoint a technical person to assist in design works																	√
Define project objectives clearly at the inception	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Establish a proper communication system	√	√	√			√		√	√		√	√	√		√	√	√
Arrange team-building activities/ regular meetings				√		√	√		√	√	√	√	√	√		√	√
Establish policy decisions at the inception	√		√														√
Appoint an independent party to delegate the authority of project management						√											
Impose contract boundaries	√	√	√	√		√	√	√	√	√	√	√	√			√	√
Educate the general public through awareness programmes on the level at which politicians can interfere with the project					√							√	√	√		√	
Conduct advanced environmental impact assessments for large scale projects															√		
Recommend available/ standard materials															√		
Build awareness about safety	√	√	√	√	√	√	√		√	√	√	√				√	√

Proposed Strategies	I-1	I-2	I-3	I-4	I-5	I-6	I-7	I-8	I-9	I-10	I-11	I-12	I-13	I-14	I-15	I-16	I-17
manuals/standards																	
Conduct feasibility studies											√	√					
Strategies to manage variations by the Consultant																	
Coordinate with the Employer									√	√							
Monitor the construction programme continually						√											
Review the design/ produce coordinated drawings	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Identify the Employer's requirements in advance									√		√						
Prepare a coordination matrix/ coordination plan				√		√	√	√	√	√	√	√	√	√	√	√	√
Deploy qualified and knowledgeable staff				√	√	√		√	√	√	√	√	√	√	√	√	√
Site investigations before the finalise the design	√	√	√			√	√	√	√		√	√		√	√		√
Make provisions for pre-ordering of materials									√	√				√	√	√	√
Draft the standard contract document		√				√			√	√			√	√	√		√
Use straightforward contract language										√							
Allow contingency provisions	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Advise the Employer on established brands/ alternatives of materials and goods						√									√		
Estimate the cost using historical data and conduct a market survey if possible	√	√	√	√		√		√	√	√	√	√	√			√	√
Incorporate relevant safety standards for contract documentation																	
Consider historical data (flood levels, rainfall, etc.) and incorporate them into the design		√		√		√		√		√	√	√		√	√	√	√
Be well-conversant with existing government regulations and potential changes	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Attend continuous professional development events and technical sessions for knowledge upgrading											√	√					
Phase-out the work to suit the available budget																	√
Conduct a market analysis and obtain suppliers' correspondence on the required materials and equipment									√								
Specify a range of products/ alternatives for items, where necessary									√	√				√	√	√	√
Strategies to manage variations by the Contractor																	
Propose value Engineering options						√											
Update the construction programme and inform the consequences to the other parties											√						
Consider a risk factor at the time of tendering										√							
Raise 'Request for Information' as early as possible																	√
Deploy a competent staff									√	√			√	√	√		√
Establish a proper communication network among the project team									√	√			√	√	√		√
Arrange manpower subcontractors									√				√	√	√		√
Adopt low labour incentive methods									√	√							
Supervise the staff and provide training facilities, whenever necessary		√											√		√	√	√
Pre-arrange funding														√	√	√	√

'Review the design', 'produce coordinated drawings' and 'allow contingency provisions' were the strategies proposed by the previous studies and conformed by all the respondents. In addition, 'well-

conversant with the existing government regulations and potential changes' was discussed as the prominent strategy to manage variations in the Sri Lankan context that can be adopted by the Consultant. The research findings revealed less number of strategies, giving the responsibility to the Contractor in managing variations. However, the Contractor can contribute to manage variations by deploying competent staff and by establishing a proper communication network among the project team members in the Sri Lankan public sector building projects.

4.3. MODIFICATIONS REQUIRED IN THE STANDARD FORMS OF CONTRACT TO FACILITATE VARIATION MANAGEMENT

CIDA/SBD/02 (2007) has provided contractual provisions to manage variations in construction projects in Sri Lanka. As indicated in Table 3, the interviewees agreed that the stipulated provisions were adequate for the time being especially in public sector building projects in Sri Lanka. They suggested that 'Sub-clause 13.4: Provisional Sums' be defined separately from 'Clause 13: Variations and Adjustments' since the two clauses refer to two different scenarios, which have to be handled separately. The Particular Conditions of Contract have to stipulate a maximum limit for the provisional sums and specify the evaluation method, the party who will design the work and when the provisional work items would commence. It was also proposed to remove 'Sub-clause 12.4: Omissions' from 'Clause 12: Measurement and Evaluation' and include it under Clause 13. The interviewees further, stated that it is necessary to have a time frame for the Engineer to approve a proposed variation relating to the scope of works, programme and costs as described in 'Sub-clause 13.3: Variation Procedure'. Then the Works relating to the variation have to commence upon a fair and reasonable approval of the same, thereby reducing the risks that the Contractor and Employer will have to face in this regard. According to Sub-clause 13.1, the Engineer may initiate the variations without obtaining the prior approval of the Employer. This could lead to the wrong use of the clause as some tend to cover-up their faults at the design stage. This shall be enlightened more as stipulated in the FIDIC Form of Contract under Sub-clause 3.1: Engineer's Duties and Authority, where the Engineer shall obtain special approval from the Employer for the works instructed under the variation clause except in an emergency, or if such variations would not increase the amount prescribed in the contract.

5. Discussion

The interviewees discussed that the change in specifications is a common cause of variations in public sector building projects in Sri Lanka. Mhando et al. (2018) discussed that the unavailability of detailed drawings and specifications before the commencement of the tendering stage would lead to claims and disputes at a later stage. Hence the respondents also argued, the Employer's requirements at the outset of the project. Proper coordination of the design process by the Consultant as discussed by Abidemi et al. (2018) and confirmed by the interviewees will minimise the ambiguities in the drawings and avoid missing elements in the design. Bello and Saka (1995) indicated that the appointment of an independent cost advisor is a good strategy for effective cost management starting from the inception of a project. Thus, the interviewees proposed to have an independent quantity surveyor to assist the Employer in the cost related matters of the project. The Contractor is entitled to receive payment for variations under the contract with the rate or the price determined by the Engineer. However, even when the rate of a particular item has not been reasonably determined by the Engineer, the Contractor has to carry out the work diligently without any delay, which will lead to disputes as it will be unfair for the Contractor, especially in public sector building construction projects. The interviewees stated that it is necessary to have a time frame for the Engineer to approve a proposed variation relating to the scope of works, programme and costs as described in 'Sub-clause 13.3: Variation Procedure'. Then the Works relating to the variation have to commence upon a fair and reasonable approval of the same, thereby reducing the risks that the Contractor and Employer will have to face.

Table 3. Compatibility of Sub – Clauses in Variations and Adjustments in CIDA/SBD/02 Conditions of Contract

Clause		Applicability		Major amendments required (if	Any other proposals to improve
Sub-Clause	**Particulars**	**Adequate**	**Inadequate**		
13.1	**Right to Vary** – Initiation of variations, what constitutes a variation	Agreed by all the interviewees	–	–	–
13.2	**Value Engineering** – the process of value engineering	Agreed by all the interviewees	–	–	–
13.3	**Variation Procedure** – the flow of establishing a variation order	Agreed by all the interviewees	–	–	▪ The works coming under variations should be implemented after getting them approved in terms of quality, time and cost (I 06) ▪ Reasons for variation should be indicated in the variation order (I 15)
13.4	**Provisional Sums** – Executing a provisional sum item by the Contractor under the variation procedure	Agreed by 16 interviewees	I-05	▪ Excluding the clause from the section and having it separately (I-05)	▪ Some additional information should be provided in Contract Data (I 15)
13.5	**Day Works** – Executing a work of minor or incidental nature as a variation on	Agreed by all the interviewees	–	–	–
12.3	**Evaluation** – valuation of variations	Agreed by all the interviewees	–	–	▪ Adjustment of Sub-clause 12.3 (a) ii. (I 09)

6. Conclusions

The study classifies causes of variations in public sector building projects as Employer –related; Consultant-related; Contractor-related; and other causes. The most significant Employer-related causes are 'changes made to plans or scope' and 'inadequate project objectives', whereas 'inadequate working drawing details' and 'design discrepancies' are the most prominent Consultant-related causes in public sector building projects in Sri Lanka. Even though the Contractor is not responsible for variations most of the time, 'differing site conditions' could be a cause of variations at the construction phase. 'Changes in government regulations' and 'unforeseen problems' are the noteworthy causes that come under other causes. The strategies to avoid or minimise variations has to be adopted by the party responsible for the variation while other parties also can adapt their strategies to avoid the variation. The respondents suggest several amendments to Clause 13.0: Variations and Adjustments in CIDA/SBD/02 Conditions of Contract. They propose to combine all the relevant clauses of variations under one section; including Sub-clause 12.4: Omissions under Clause 13; and excluding Sub-clause 13.4: Provisional Sums from Clause 13. Further, the delegation of authority to the Engineer shall be rationalised in a way that no party to the contract get affected on Engineer's instructions under Sub-clause 3.1. The study revealed a range of causes of variations and strategies to manage variations in public sector building projects in Sri Lanka. The outcome of the study would be useful to the parties to a contract to identify the possible causes of variations in advance. Further, the strategies mentioned could be used to overcome the effects of variations and avoid disputes among the parties to a contract.

The study can be extended by modelling a management framework for variations in construction projects in Sri Lanka.

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CROSS-CULTURAL DIMENSIONS AND CROSS-CULTURAL ORIENTATIONS IN CONSTRUCTION PROJECTS: CASE STUDY OF SRI LANKA

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Abstract.
Significant issues affecting the success of construction projects due to globalisation is the establishment of a multicultural project team. Presently, China has emerged as one of Sri Lanka's main sources of foreign and commercial loans in an environment, where the island is seeking to rebuild and modernise infrastructure. However, the involvement of multi-cultural project teams often present unique challenges due to cross-cultural interactions, thereby, creating conflicts through construction projects, makes the conflict unavoidable. Therefore, this study was attempting to identify the cross-cultural dimensions and cross-cultural orientations in cross-cultural teamwork of Chinese contractors in construction projects in Sri Lanka. A qualitative approach was followed in this study in which multiple case study was selected as the most appropriate method for the research. Accordingly, semi-structured interviews were conducted among the selected four (4) respondents from each case to collect the data. Captured data was analysed by the manual content analysis method. An empirical investigation has been validated communication, leadership, trust, collectivism, team selection, uncertainty, team development and management as the common cross-cultural dimensions for all the three cases. This study added new cross-cultural dimensions to the literature in the context of Sri Lankan construction industry namely, coordination, harmony and customs with specific cross-cultural orientations. The study can be further developed to investigate strategies to manage intragroup conflicts occurs in cross-cultural teamwork of Sri Lankans and Chinese professionals in the Sri Lankan construction industry.

Keywords: Construction projects, Cross-culture, Cross-culture dimensions, Cross-culture orientations, China, Sri Lanka

1. Introduction

In the construction industry, International Projects allow the industry of developing nations to evolve through the teamwork with firms of developed nations (Raftery et al., 1998). According to Xiao and Boyd (2010), the participation of other nationalities for the construction project works became manifestation due to the advance outlooks of design, materials, construction methods, technologies, teamwork and management aspects. However, in developing countries, when construction activities are heavily influenced by the foreign participants, cross-cultural interactions become a key role in negotiations, decision making, problem-solving and various other construction organisation transactions (Ochieng & Price, 2009). Cross-cultural teamwork necessitates interrelations with team members, whose social aspects are prejudiced by other cultural significances corresponding to skills in communication, leadership, interpersonal (Pheng & Leong, 2000). These cultural differences might create misunderstanding between people and businesses, forming conflict risks and making dissatisfaction among construction project participants (Tijhuis, 2011).

Intragroup conflicts play a foremost role in project delivery on time without delays (Ng et al., 2007). Conversely, foremost serious distinctive of the construction is the involvement of various nationalities invited as a cross-cultural team to perform work together in projects (Harmon, 2003). The project management team should enthusiastically concentration on avoiding and preventing conflict strategies in the cross-cultural team by considering cultural dimensions of different nationalities from rising conflict into claims, consequently further resolving claims to prevent from becoming as disputes (De Dreu & Van Vianen, 2001).

The increased global nature of construction projects highlights the importance of multiculturalism that lead to successful project execution (Ochieng, & Price, 2010). However, there is no consensus on empirical work that elaborate explicitly the extent to which cross-culture affects Sri Lankan construction industry. Therefore, this study investigates how cross-culture impact the teamwork by identifying the cross-cultural dimensions and cross-cultural orientations in cross-cultural teamwork of Chinese contractors in construction projects in Sri Lanka.

2. Nature of Cross-Cultural Projects in the Construction Industry

International construction projects consist of contractors, consultants, and employers coming from multi-cultural backgrounds, at least one of which works outside the country of origin (Chan & Suen, 2005). The construction industry shall make the optimum use of international construction opportunities and contribute to the development of materials, plants and equipment, project documents and procedures, human resources, technology and institutions (Ofori, 2000).

Cross-cultural construction project teams have a common set of values and beliefs, where beliefs refer to people's perceptions on how things are done in an organisation and are reported as "practices" in a particular culture and values refers to the way that the people think about how things should be done correspondingly in their preferred practices (Ochieng & Price, 2009). Socioeconomic and cultural changes are increasingly confusing, and the globalisation of the construction industry has brought many challenges to project stakeholders at all levels (Lewis, 2007). In overseas construction projects, organisations must help their project managers to understand the international context and improve their ability to understand everyday issues from a variety of cultural perspectives (Ochieng & Price, 2009). Differences in values, attitudes, perceptions, and behavioural norms affect the people, who are working in a cross-cultural environment in numerous ways (Xiao & Boyd, 2010).

Global construction projects involving collaborations between participants from multiple countries often creating unique challenges and cost overruns due to cross-border interactions (Mahalingam & Levitt, 2007). Coordination of key behavioural dimensions refers to the coordination and integration of culture and project participants in different levels, helping project participants to understand the interaction of their behaviours and ensuring all project members work together to achieve common goals (Nguyen, 2019). When managing multicultural teams, these are synthesised into a framework of eight key dimensions to consider (Ochieng & Price, 2009), which are discussed in the next section.

3. Cross-Cultural Dimensions and Orientations

Major distinctive of the construction is the involvement of various nationalities incurred as a cross-cultural team to perform to work together with the aids of project scope (Harmon, 2003). Managing cross-cultural teams in the construction industry need to consider every nationality specific cultural value (Ochieng & Price, 2009). Table 1 shows eight types of cross-cultural dimensions together with their cross-cultural orientations identified in the previous research.

Table 1. Cross-cultural dimensions and the associated cross-cultural orientations

Cross-cultural dimensions	Description	Source of reference	Cross-cultural orientations	Sources of reference
Communication	Communication in projects helps build and maintain relationships by team effectiveness [2]	[2], [6], [8], [9], [10], [11]	Emotional dependence	[1], [5], [7]
			Team effectiveness	[3], [4], [6]
			Language	[1], [3], [4], [5]
			Empathy	[3], [5]
Leadership	Cross-cultural leadership style makes team members share their own opinions, ideas and attention with the leader that can helpful for the efficient project performance [6]	[2], [4], [8], [9]	Responsive	[2], [5], [7]
			Inspirational	[5]
			Charismatic	[1], [5], [7]
			Attention	[7]
			Confidence	[1], [2], [3], [5], [7]
Trust	Cross-culture team members need to concern for the trustworthy to meet expectation induced by oppression [2]	[2], [6], [11]	Concern	[2], [4]
			Obey	[1], [3], [5]
			Trustworthy	[1], [2], [4],

			Reliable	[6] [4]
Collectivism	Collectivism combine different cultural people as a team by considering each specific cultural values, comprising the characters of each individual and group goals to the high performance of team [6]	[6], [9], [10]	Commitment Open decision making Participatory Kindness	[2], [5], [7] [2], [3], [6] [1], [5] [1]
Team selection	Effective team selection coherent the vision, the intent of the project, potential solutions and help to remove barriers faced by construction teams [8]	[4], [8], [9]	Ability to work Fit into the team Technical ability Individuals offer	[4], [5], [6] [5], [6] [6] [1], [6], [7]
Uncertainty	Uncertainty indicates the supposed threat in cross-cultural construction projects [2]	[2], [8], [10]	Reduce uncertainty Interpersonal skills	[7] [1], [3], [7]
Team development	Team development fairly creates high-performance project team with cross-cultural team members [9]	[4], [9], [11]	Team building Reward Team loyalty Recognition Individual drivers	[2], [4], [6] [1], [6], [7] [1], [2], [4], [5] [1] [1], [5]
Management	This signifies proper documentation, time management, administrative management and resource management in successful project delivery without conflicts [10]	[2], [4], [6], [8], [9] [10]	Team cohesion Cooperative Interdisciplinary Open communication	[1], [2], [7] [6], [7] [1], [4], [5], [7] [4], [7]

[1] Brockman (2013); [2] Carmeli (2003); [3] De Dreu and Van Vianen (2001); [4] Friedman, Chi and Liu (2006); [5] Lee and Rogan (1991); [6] Tinsley and Brett (2001); [7] Tjosvold, Hui, Ding, and Hu (2003); [8] Simons and Peterson (2000); [9] Yuki (2003); [10] Jehn (1994); [11] Boonsathorn (2007)

4. Chinese Culture into Sri Lankan Construction Projects

In the current context, Sri Lanka has been identified as a foremost concern country for the construction by foreign countries due to its irreplaceable location and economic growth. Additionally, Hillman (2018) supported that China has become an attractive economic partner to the Sri Lankan construction industry. Furthermore, the author expressed that hasty socio-economic improvement and high-rise construction projects are currently under construction by China. Huge investments, a combination of contractual provisions and numerous stakeholders with various nations are these significant features of Chinese involvement to the construction industry.

Pheng and Leong (2000) found Chinese cultural characteristics, which Sri Lankans need to be aware of while working as a team as trust, emotional dependence, honest and gratitude. Those are the significant values that substantially rely on the contracts both locally and internationally between the parties to the contracts. Chinese culture is deeply influenced by team development, which built on loyalty, team building and leadership that came from a morally superior individual, who does virtuous performances and all these features ask for collectivism in favour of harmony in a community (Chan, 1997).

5. Research Methodology

The study aimed to identify the cross-cultural dimensions and cross-cultural orientations in cross-cultural teamwork of Chinese contractors in construction projects in Sri Lanka. Thus, the research question of the study was 'what are the cross-cultural dimensions and cross-cultural orientations in Chinese cross-cultural teamwork in international construction projects in Sri Lanka?' An exploratory

case study is selected as the research strategy, "what" type of research questions are supported by exploratory, which can be developed further, into theories propositions relating to the study (Yin, 2009). Accordingly, three ongoing multi-complex projects in Sri Lanka were selected as cases in this study. Table 2 summarizes the profile of selected cross-cultural construction projects in Sri Lanka. Every project consist team consisted of a Chinese contractor as the main contractor and Sri Lankans work as the consultant. These projects build by Chinese contractors under the supervision of Sri Lankan Consultants. Four respondents were selected from the top management, where two respondents from the contracting organisation and the rest were from the consulting organisation. Semi-structured interviews were conducted to collect the data and the captured data was analysed by the manual content analysis method. Table 3 presents the respondent's details in three cases.

Table 2. Profile of the Cases

Case	Description
Case A	• Hotel and Residences complex • Comprises of 42 storey hotel and 30 storey residence • To be completed by 2021
Case B	• Residences and office complex • Comprises of 50-storey office tower and residence with a shopping mall • To be completed by 2020
Case C	• Hotel and Residences Complex • Comprises of 55-storey residential, 29 storey hotel with a shopping mall • To be completed by 2021

Table 3. Profile of the Respondents

Case	Respondent's code	Designation	Work experience
Case A	A1	Chartered Quantity Surveyor	15 years
	A2	Planning Engineer	10 years
	A3	Site Engineer	13 years
	A4	Senior Quantity Surveyor	18 years
Case B	B1	Senior Quantity Surveyor	15 years
	B2	Site Engineer	18 years
	B3	Project Manager	20 years
	B4	Planning Engineer	15 years
Case C	C1	Chartered Quantity Surveyor	17 years
	C2	Planning Engineer	15 years
	C3	Project Manager	25 years
	C4	Site Engineer	13 years

6. Research Findings and Analysis

6.1. CURRENT LEVEL OF CHINESE CROSS-CULTURAL TEAMWORK WITH SRI LANKANS

All the respondents in three cases agreed that the involvement of the foreign workforce has been increased in the Sri Lankan context. This is because of the need for high skilled and technical knowledge among workers as highlighted in Case A. Further, Case C respondent added unavailability of construction materials results to make arrangements with foreign suppliers. Therefore, working with foreign participants has become a success and it enhances the construction team members to work with the cross-cultural team. However, Case B emphasised communication barriers, cultural differences, time-consuming approvals hinder the cross-cultural teamwork in Sri Lanka.

6.2. CROSS-CULTURAL DIMENSIONS AND CROSS-CULTURAL ORIENTATIONS

With the development of globalisation and the internationalisation of the construction industry, China and Sri Lanka subordinate closely with each other in aspects of construction. Managing cross-cultural teams in the construction industry need to consider the specific cultural values of every nationality. Accordingly, the various cross-cultural dimensions identified in the literature were further elaborated by the respondents in the perspective of international construction projects in Sri Lanka. Besides, several new cross-cultural dimensions and cross-cultural orientations were found from the expert opinion survey, as discussed in next.

6.2.1. Communication

'Lack of communication' was stated as a cross-cultural dimension by all respondents from all Cases. 'Meetings decision are made in Chinese languages' and 'difficult to argue their viewpoints on their own languages' were identified as reasons for communication barriers in Case A and Case B, respectively. Respondent A2 disclosed, 'non-adherence to cross-cultural communication and misunderstanding of communication with Chinese and Sri Lankan people causes intragroup conflicts'. Respondent B3 further acknowledged that they are facing issues mainly due to language barriers between Chinese and Sri Lankans, as it was the main reason for occurring conflicts in cross-cultural projects. Case C was not considered that this become challenge for them, where they are well-developed mobile device use as a translator and all decisions are made in the English language as it is common for Sri Lankan and Chinese. Respondent C4 expressed that the cooperation between cross-cultural team members is essential for proper interpretation of information passing through the cross-cultural team members.

6.2.2. Leadership

Cross-cultural dimension, 'Leadership' was notified by all the three cases. The respondents from all the cases agreed that 'differing opinions coming from superiors' and 'confusion on different roles of team members' were the main reasons for the intragroup conflicts due to cross-cultural teamwork, which can be overcome through proper leadership. Further, B3 expressed that 'the unclear instructions and information by other party or the supervisor result in poor leadership within cross-cultural team members of Chinese and Sri Lankans'. Besides, respondents from Case A and Case C emphasised 'influence of personal skills' and 'team member's well-being' also influence intragroup conflicts in cross-cultural teamwork. Moreover, C4 stated that "leadership behaviours are associated with distinct cultural traits, which reduce the charismatic and brush up the knowledge of us about different cultures".

6.2.3. Trust

'Trust' was notified by all the respondents as a cross-cultural dimension. All the respondents in the three cases agreed that the major reason for the intragroup conflicts in cross-cultural teamwork due to trust effect the reliability and trustworthiness. A1 expressed that 'differing opinions of cross-cultural teamwork professionals and apprehension between Chinese and Sri Lankans are affected by trust'. Similarly, according to Case A and Case B 'intolerance among team members' was the main reason for the intragroup conflicts due to cross-cultural trust by Chinese and Sri Lankans. Trust among team members validated by respondents B4 and C3 as they are concerned about developing successful relationships within cross-cultural team members of Chinese and Sri Lankans by taking their time and concerning their recent past performance.

6.2.4. Collectivism

Cross-cultural dimension, 'collectivism' was notified by all the respondents in the three cases. According to cases A and C, 'self-identity' and 'interaction among individuals from various national backgrounds' were the agreed factors, which influence the intragroup conflicts due to cross-cultural collectivism by Chinese and Sri Lankans. Collectivism among team members validated by B3, as they

were always giving the priority to the needs of cross-cultural team members, associated with indirect and passive communication. Respondent C3 stated that 'we are giving priority to work as collectivism rather than individualism' by highlighting the positive impact to the cross-cultural teamwork of Chinese and Sri Lankan people. From the outcome of the study, kindness and equity were added as cross-cultural orientations for collectivism in this research.

6.2.5. Team Selection

'Team selection' was stated as a cross-cultural dimension by all the respondents from all the cases. In cases B and C, the respondents have identified that 'ignoring team resolutions' creates intragroup conflicts between Chinese and Sri Lankans. Respondent A3, further mentioned that 'improper team selection', 'fewer opportunities for creativity', and 'irregular operating procedures for timeliness works on-site' cause intragroup conflicts within the cross-cultural team. Moreover, B2 expressed that information gaps between team members discourage the work progress within the project and underestimate the value of tolerance and politeness, thereby occurring intragroup conflicts between Chinese and Sri Lankan people.

6.2.6. Uncertainty

The 'uncertainty' was notified by all the respondents in the three cases as a cross-cultural dimension. Uncertainty affects the cross-cultural construction projects in ways of concern for efficiency, socio-economic stress, formal and informal values, the ways of communication and behaviour within the project environment, collaboration in the supply chain while indicating the need to address cultural complexity in cross-cultural construction projects. Respondent A2 signified, 'improper management of inherent uncertainty' as the main reasons for the intragroup conflicts. B1 expressed more causes for this as 'failure of carrying out a task in construction' and the 'ways of communication patterns with other nation's professionals'.

6.2.7. Team development

Cross-cultural dimension, 'team development' was reported by all the respondents in three cases. Case C highlighted, cultural diversity and sharing of responsibilities to optimise team performance as the major reasons for the intragroup conflicts in cross-cultural teamwork. The respondents of case A indicated, 'gratitude of team members' and 'individual drivers' positively impact the team development of cross-cultural teams of Chinese and Sri Lankans. Also, B1 and B3 proposed to illuminate the cultural variances to expedite the understanding and enhance the team performance.

6.2.8. Management

Cross-cultural dimension, the 'management' was also reported by all the respondents from three cases. In Case A, A1 argued that the lack of open communication was a barrier to present their ideas and work cooperatively within cross-cultural teams. According to B2, low-level team cohesion influences the time, work and cultural change in the cross-cultural projects while lacking comprehension effects poor management within the team. In Case C, all the respondents confirmed, team development affects the clear identification of project objectives and construction methodologies while emphasising the need of managing the culture to enhance the performance of cross-cultural construction project teamwork.

6.2.9. Customs

Cross-cultural dimension, 'customs' was additionally notified from Case B. It needs to be managed the challenges and minimise the misconducts within team members in a kindly manner to cope with various traditions for the success of project progress by avoiding conflicts. B2 supported this by stating, 'our team members shall react in a manner to avoid complications, when working with

Chinese people. This was further validated by B4 as the Chinese people always give priority to the effective construction process, international operations management and negotiations.

6.2.10. Coordination

'Coordination was added as a new cross-cultural dimension by case A respondents as an addition to the literature findings. This needs mutual understanding within team members for successful project delivery. A3 highlighted that 'flexibility of our team members to present their problems, ideas, thoughts and opinions also need to be considered, when working with Chinese people'. This statement was further validated by A4, as they always give priority to work done rather than considering documentary. And also, they always allow team members to work with flexible manner.

6.2.11. Harmony

'Harmony' was identified as another cross-cultural dimension from cases A and B, which was not found in the literature. A2 said, 'values, beliefs, opinions and moral within team members need to be considered, when working with Chinese as they are always giving the priority to others opinions, which gives positive values for their works related to construction'. A4 mentioned that 'valuing long-term co-operation for our mutual benefits also affects cross-cultural teamwork'. Respondent B2, from case B, expressed that 'hierarchy of the Chinese is different from our hierarchy as they give priority to their hierarchical arrangement for a particular construction project than us'.

7. Discussion

The case study approach aimed to analyse the cross-cultural dimensions and cross-cultural orientations faced by cross-cultural team members of Sri Lankans and Chinese on construction projects in Sri Lanka. Altogether eleven cross-cultural dimensions regarding cross-cultural teamwork were identified in the perspective of the Sri Lankan context. All the respondents from the three cases mentioned that communication, leadership, trust, collectivism, team selection, uncertainty, team development and management are cross-cultural dimensions in the cross-cultural projects. In addition to the literature findings, cases A and B added 'harmony' as a new cross-cultural dimension, whereas 'coordination' and 'customs' were added from case A and case B respectively as they were not recognised from the previous research. The comparison of literature and case study findings were presented in Table 3 through pattern matching effort. 'Chinese cross-cultural teamwork' was highlighted by all the respondents from three Cases. It was evident in Case A that the occurrences of a result, when the team members having dissimilar cultures come into perpetual interaction of construction projects, with subsequent changes in the original cultural patterns of teams. Case B highlighted that the cross-cultural adaptation process possess different cultures from Sri Lanka and China, thus, the team members should deliberate from two dimensions to keep the traditional culture and distinctiveness orientations in cross-cultural dimensions.

Table 3. Pattern matching of findings

	Cross-cultural dimensions	Cross-cultural orientations	
		Literature Findings	**Case study Findings**
Literature Findings	**Communication**	Emotional dependence, Team effectiveness, Language, Empathy	Honesty, Respect, Cooperation
	Leadership	Responsive, Inspirational, Charismatic, Attention, Confidence	Authoritarian, Personal skills, Well-being
	Trust	Concern, Obey, Trustworthy, Reliable	Faithful, Integrity, Goodwill
	Collectivism	Commitment, Open decision making,	Equity

Case study Findings	**Team selection**	Participatory, Kindness Ability to work, Fit into the team, Technical ability, Individuals offer	Collaboration, Complexity, Team spirit
	Uncertainty	Reduce uncertainty, Interpersonal skills	Hesitation, Unwillingness, Wavering, Taking initiative
	Team development	Team building, Reward, Team loyalty, Recognition, Individual drivers	Gratitude, Team identity
	Management	Team cohesion, Cooperative, Interdisciplinary, Open communication	Unity, Supportive Motivation, Collaboration
	Coordination		Performance, Promotion, Mutual understanding, Blameworthy, Flexible
	Harmony		Values, Beliefs, Freedom, Morals, Views, Hierarchy, Ideals, Attitudes, Opinion
	Customs		Challenge, Conservatism, Reaction, Opposition, Hostility, Manners

8. Conclusion

With the economic growth, Sri Lankan construction industry collaborates with Chinese construction professionals to uplift the construction industry. This multiculturalism allows new solutions for the lack of skilled workforce and technological improvements. In international context, 'Communication', 'Leadership', 'Trust', 'Collectivism', 'Team selection', 'Uncertainty', 'Team development', and 'Management' were identified as cross-cultural dimensions. Cross-cultural dimensions of Chinese cross-cultural teamwork, identified in the Sri Lankan context are in line with an international perspective. In addition to the findings of the literature, 'Coordination', 'Harmony' and 'Customs' were also highlighted as cross-cultural dimensions in the Sri Lankan context through case studies. Cross-cultural orientations related to relevant cross-cultural dimensions are acknowledged in this research. Further, this study added new cross-cultural orientations to the literature as signified in Table 3. As an example, for the cross-cultural dimension 'Communication'; 'Emotional dependence', 'Team effectiveness', 'Language' and 'Empathy'. Moreover, 'Honesty', 'Respect' and 'Cooperation' were identified as cross-cultural orientations associated with 'Communication' as specific to the Sri Lankan context. Similarly, a range of cross-cultural orientations was identified relating to the cross-cultural dimensions elaborated in the study. This study aimed to present cross-cultural dimensions and cross-cultural orientations in cross-cultural teamwork of Chinese contractors in Sri Lankan construction projects which have not been discovered as facts in the existing literature. The outcome of the study can be used to analyse the relationship between intragroup conflicts and cross-cultural dimensions in construction projects in Sri Lanka.

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EXPLORING CHALLENGES AND DRIVERS OF FACILITIES MANAGEMENT OUTSOURCING IN SRI LANKA

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Abstract
There has been a growing trend of organisations adopting a sourcing strategy that increases their competitive advantages through improving the performance of their facilities management (FM) services. Facilities Management Outsourcing (FMO) is a management strategy whereby FM services are contracted to one or more external providers with the aim of improving organisational efficiency and effectiveness. However, this kind of contract procurement is yet to acquire its full potential in Sri Lanka and thus, it is vital to unfold its current status and make suggestions for enhancement. Therefore, a study was conducted to investigate the existing FMO challenges, drivers and the strategies to overcome those challenges in Sri Lanka. Initially, a literature review was made on FM services sourcing strategies, challenges and drivers of FMO. Then a qualitative approach was taken to carry out semi-structured interviews with six FM experts in the industry. The data captured was structured and analysed by using a manual content analysis method. Fourteen challenges and eleven drivers were revealed as significant to FMO. The results of this research, which contribute to the understanding on FMO, serve as a cornerstone upon which further studies can be pursued in the context of FM in Sri Lanka and countries in a similar state of FM development.

Keywords: *Challenges; Drivers; Facilities Management; Outsourcing; Sri Lanka*

1. Fundamentals and Trends in Facilities Management

Facilities management (FM) is the process where an organisation provides and maintains support services in a quality environment to meet strategic needs (Parn, Edwards and Sing, 2017). As an integrated approach to maintaining, modifying and upgrading the building facilities, FM creates an environment which supports achieving the primary objectives of an organisation (Barrett and Baldry, 2003). As IFMA (2016) defined, FM is a profession encompassing multiple disciplines to ensure proper functionality, safety, comfort and efficiency of the built environment by integrating people, place, process and technology.

With the rapid advancement in technology development, FM practice has witnessed increased levels of sophistication in its day-to-day operations (Adama and Michell, 2018). This is also driven by the increased competition in modern economies (Islam, Nazifa and Mohamed, 2013) that demand work spaces which are conducive to higher productivity. FM covers a wide spectrum of activities, including operation and maintenance of engineering services, security, health and safety, housekeeping, pest control, car parking and space planning in a built environment (Kurdi, et al., 2011; Drion, Melissen and Wood, 2012; Perera, et al., 2015). Traditionally, most of these activities are performed by in-house staff. However, with the increases in building stock with sophisticated facilities, the reliance on in-house FM has been changing to an "outsourcing method" (Yik and Lai, 2005; Wiggins, 2010; Sridarran and Fernando, 2016). Moreover, Facilities Management Outsourcing (FMO) has become a modern global trend (Willcocks, 2010).

2. Facilities Management Outsourcing

The term Facilities Management Outsourcing (FMO) can be defined as 'contracting out the FM services to an external provider through a formal contract over a given period' (Atkin and Brooks, 2009; Adegoke and Adegoke, 2013). It is one of the most widespread business strategies to address organisational needs efficiently, both in public and private sectors (Jiang, Frazier and Prater, 2006; Kurdi et al., 2011).

The trend towards FMO has increased with the rapid changes in the competitive business environment that forced organisations to focus on their core business activities (Willcocks, 2010; Sridarran and Fernando, 2016). The increased demand for the outsourcing of services has largely contributed to the growth of the profession (Cathy, Michael and Amir, 2013). As Ahamed, Perera, and Illankoon (2013) revealed, FM services outsourcing is an increasingly used method for achieving increased efficiency in performance and improvements in cost effectiveness.

2.1. TYPES OF OUTSOURCING STRATEGIES IN FACILITIES MANAGEMENT

Rapidly rising needs for FM combined with the increasing interest of adopting outsourcing emphasise the imperative for organisations to make right decisions on selecting proper strategies for sourcing services (Ancarani and Capaldo, 2005). Based on the nature of services and the terms of contract, three types of outsourcing strategies are commonly used; Managing Agent, Managing Contractor and Total FM (TFM) (Atkin and Brooks, 2009). The selection of a suitable outsourcing strategy depends on cost consideration, risk transfer and flexibility (Ikediashi, 2014). The following Table 1 shows the summarised facts of outsourcing strategies in FM from the existing literature (Atkin, 2003; Atkin and Brooks, 2009; De Silva., 2018; De Toni et al., 2012; Hamzah et al., 2010; Ikediashi and Aigbavboa, 2019; Sridarran and Fernando 2016).

Table 18: Comparison between outsourcing strategies in FM

	Managing Agent	**Managing Contractor**	**TFM**
Definition	A specialist (individual or corporate entity) assigned to arrange and procure or provide FM services and act on behalf of the client in arranging the services.	An external party appointed by the client to manage all the service providers of the organisation.	A sourcing method where all FM services and their management are provided by an organisation that specializes in this field and offers a single point solution to the client.
Roles and responsibilities	Act as a direct representative (agent) of the client organisation.	Select, manage and coordinate individual service providers/sub-contractors.	Totally responsible for delivery, monitoring, control and managing the outsourced services.
Contractual relationship	No direct contractual relationship between managing agent and the individual service providers.	All the individual service providers maintain contractual relationships with the managing contractor.	Client signs FM contract with an outsourcing company.
Control of FM services	Client and vendor have control over the activities to be performed by themselves and client can predefine the requirements of services to be provided by the vendor.	Certain level of control remains with client through managing contractor who has direct control	Client has no direct control of outsourced services, so must specify requirements in advance.

2.2 CHALLENGES OF FACILITIES MANAGEMENT OUTSOURCING

Although the transition to FMO leads to a variety of benefits to the organisation, the challenges in FMO may lead to undesirable consequences in the expected performance of FM services. According to Ikediashi, et al. (2012), the identification of the challenges in FMO is crucial, since these can impact on the success or failure of an outsourcing relationship between client and vendor. In one of their past studies, Ikediashi, Ogunlana and Udo (2013) revealed that minimal vendor accountability for service performance, improper invoicing and billing practices, lack of knowledge (resulting from high turn-over, including discontinuations of serving staff), higher management overhead, critical service failures, underperformance of service providers and 'cultural rejection' due to 'cultural conflicts' between the interacting teams, were significant practical problems in FMO.

In a survey conducted by Ikediashi, et al. (2012), poor quality of services, security issues and inexperienced client were found to be the three highest challenges in FMO. Furthermore, absence of a standard form of contract, poor understanding of contract formation and contracts, lack of benchmarks for quality, inadequate definition of scope of services, unclear roles, responsibilities and targets, shortfalls in procedures for awarding contracts and unfavourable contract terms were highlighted as critical contractual issues in outsourcing (Lai, et al., 2004; Lai, et al., 2006; Ikediashi, et al., 2012; Ikediashi and Ogunlana, 2015).

Atkin and Brooks (2009) established a set of risks associated with outsourcing faced by the FM industry, such as imprecise roles and responsibilities, poor relationship between client and contractor, loss of control in FM services, conflicts of interest when sharing works with the in-house team, lack of standard FM contracts, poor scope and schedule of services and poor quality and cost benchmarks for measuring performance. In addition, use of different methods to perform standard activities, poor control of service delivery which leads to interruption of services, absence of adherence to proper guidelines and delays in delivery were highlighted as risks associated with FMO (Ahmed, at al., 2013; Perera, et al., 2015).

2.3 DRIVERS OF FACILITIES MANAGEMENT OUTSOURCING

A number of studies have identified various drivers (Cigolini, Miragliotta and Pero, 2011; Parn, et al., 2017) that are conducive to the practice of FMO in the organisations. For example, Kurdi, et al. (2011) developed an outsourcing decision framework where cost saving is highlighted as an important driver to make outsourcing decisions. A study by Ahamed, et al. (2013) concurred that good practices in FMO enabled an organisation to achieve better efficiency and cost-effectiveness of delivered services, and reduced cost through specialisation and flexibility.

According to Ikediashi, et al. (2014), the key determinants of FMO are cost transparency, quality of service delivery, increased efficiency in supporting services and time saving. Higher quality of service, increased access to new technologies and expertise, paying more attention to the core function of the organisation (Cigolini, et al., 2011), cost savings, risk transfer, single point responsibility, strategic positioning and reduced managements' burden on non-core functions of the organisation, were also identified as drivers of outsourcing (Natukunda, Pitt and Nabil, 2013; Ikediashi and Aigbavboa, 2019).

3. Research Methodology

Research design is a plan which should identify particular tasks to be conducted by whom, when and how, in order to complete the research process (Polonsky and Walker, 2011). The current study commenced with a literature review on FMO, including an overview of the trend of FMO, types of FMO, and challenges and drivers of FMO. According to the literature review findings, no prior studies have been conducted to reveal specifically the challenges and drivers of FMO in Sri Lanka. To address this knowledge gap, the following research questions were formulated for the current study:

- What are the challenges of FMO in Sri Lanka?
- What are the strategies to overcome the challenges of FMO in Sri Lanka?
- What are the drivers of FMO in Sri Lanka?

According to Creswell (2014), research plans and procedures are developed from research approaches which translate comprehensive assumptions to processes that provide the detailed data collection and data analysis methods. Basically, research approaches are classified into three methods viz., qualitative approach, quantitative approach and mixed approach, where the qualitative approach was chosen to better achieve the aim of this research study based on its characteristics and benefits and available data, compared to the other methods. Considering the nature and depth of issues to be

explored, semi-structured interview was selected as the method for data collection. Accordingly, given the time and resource constraints, six substantive experts were selected from the industry. Their profile is summarised in Table 2.

Table 2: Profile of the Interviewees'

Respondents' code	Designation	Nature of business	Years of experience
R1	Manager System Complaints	Health Care	13 years
R2	Head of FM	Commercial	10 years +
R3	Head of FM	Financing	6 years +
R4	Senior Engineer Facilities	Commercial	6 years +
R5	Facilities Engineer	Commercial & Industrial	10 years
R6	Manager Facilities	Telecommunication	25 years

Manual content analysis was used in this study to analyse the data collected through the expert interviews.

4. Analysis and Discussion

4.1 CHALLENGES OF FACILITIES MANAGEMENT OUTSOURCING

Based on the literature survey, eighteen challenges were identified. Each of these was thoroughly discussed with the expert interviewees as to whether the respective challenge applies in the context of FMO in Sri Lanka. The responses to this part, as summarised in Table 3, shows that fourteen challenges were recognised as significant to FMO in Sri Lanka.

Table 3: Responses on challenges of FMO

No	Challenges	R1	R2	R3	R4	R5	R6	Count
Factors identified from literature								
1	Lack of knowledge	√	√		√	√		**4/6**
2	Poor coordination between client and vendors	√		√	√		√	**4/6**
3	Higher management overhead	√	√		√	√	√	**5/6**
4	Cultural change	√	√	√	√	√	√	**6/6**
5	Vendor underperformance	√	√		√		√	**4/6**
6	Poor quality and benchmarks for measuring performance	√			√		√	**3/6**
7	Security issues						√	**1/6**
8	Critical service failures				√		√	**2/6**
9	Loss of control in FM services	√	√		√	√	√	**5/6**
10	Conflicts of interest	√		√	√	√	√	**5/6**
11	Poor understanding of contract formation and contracts							
12	Poor scope and schedule of services							
13	Lack of procedure for awarding contracts							
14	Unfavourable contract terms							
15	Improper invoicing and billing practices							
16	Unclear responsibilities and targets							
17	Absence of standard form of contract							
18	Inexperienced client							
Newly added factors								
19	Flexibility		√	√				**2/6**
20	Inexperience and lack of required skills					√	√	**2/6**
21	Integrity issues		√				√	**2/6**
22	Difficulty in finding the correct vendor	√	√	√			√	**4/6**

All the respondents agreed that it is crucial to have a strong concern and an understanding of the challenges that influence the performance of outsourced services in an organisation. Fourteen challenges (Nos. 1-10 and 19-22) were explored and the experts further emphasised that these challenges are interrelated.

'Cultural change' was identified as one of the significant challenges of FMO, where the practice of outsourcing influenced a wide scope of changes such as functional changes, hierarchical changes and changes in workers' behaviour and attitudes. In addition, a few other challenges are: 'higher management overhead', where the organisation has to provide additional training and awareness programmes to familiarise the outsourced vendor with the internal environment; and 'negative behaviours and attitudes of workers', where the in-house and outsourced teams work together. Based on the respondents' opinions, another significant issue in FMO is conflicts of interest when works are shared between the in-house and outsourced teams.

On the other hand, four of the six respondents agreed that 'poor coordination between client and vendor' can be an issue of outsourcing in case the organisation selected inappropriate vendors to perform the FM services. Furthermore, they revealed that although the demand for outsourcing is rapidly increasing, client organisations are still struggling with the selection of appropriate vendors for the needed services, as the presence of inexperienced and unskilled vendors in the market often leads to the inadequate performance of such vendors in delivering FM services and failures in critical services. These challenges were in line with the literature findings.

Contractual issues (Nos. 11-17 in Table 3) were addressed as significant challenges in the literature (Lai, et al., 2004; Lai, et al., 2006; Ikediashi, et al., 2012; Ikediashi and Ogunlana, 2015). Contrary to the literature review findings, the respondents clearly did not agree with factors 11-18 (in Table 3) as challenges in the Sri Lankan context, because they typically have well-structured contract agreements that are prepared by considering the requirements of both parties involved (client and vendor). This in practice assists in minimising the contractual problems in outsourcing. Furthermore, they confirmed that an improper contract will lead to critical issues in the performance of the outsourced services. Additionally, R2 stressed that using a proper contract document is essential in outsourcing since some do face difficulties in awarding and monitoring contract performance, when informal contracts are used. Besides, all the respondents agreed that, in this modern world, most of the clients are aware of FMO and are competent enough to manage it effectively. Therefore, the 18th challenge 'in-experienced client' (in Table 3), which was identified from literature, could not be considered as a critical challenge in the current Sri Lankan context.

In addition to the literature findings, four new challenges (Nos. 19-22 in Table 3) were added to the list as per the opinions of respondents. In particular, 'flexibility' plays a dual role as challenge and driver of FMO where it was only identified as a driver in the literature. R2 highlighted that 'lack of flexibility' is an issue if the FM services are partially performed by the vendor and there is a high influence of the client. As per the responses of R2 and R6, 'integrity issues' is also added as a challenge, as they disclosed that workers from outside often focus on their own businesses and profitability rather than the interest of the client.

According to the results of the interviews, the following strategies are suggested to overcome the challenges in FMO which presented in Table 4.

Table 4: Strategies to overcome the challenges in FMO

Strategies	Description
Appoint a specific management team	It is necessary to have a specific team of experts to select and coordinate the suitable vendors and to assess and maintain the performance of selected vendors.
Follow a proper contract management system	It is crucial to use a proper contract to direct both client and vendor. This helps to prevent the conflicts between parties involved.

Conduct awareness programs for the in-house staff	Client organisation has to conduct awareness programs to educate their in-house staff on outsourcing strategies and their roles and responsibilities.
Develop a proper performance measurement system	Client organisation should develop a performance measurement system which includes a set of suitable key performance indicators, frequencies of measurements and continuous improvements in the performance of outsourced services.

These strategies can be used to minimise the challenges in FMO as well as to improve the practice and performance of FMO.

4.2 DRIVERS OF FACILITIES MANAGEMENT OUTSOURCING

Results showed that factors which triggered FMO varied from organisation to organisation, depending on the nature of the business concerned. It was found that for the FMO drivers under investigation, the opinions of the interviewed experts largely align with the literature review findings. The analysed drivers were organised based on the responses of experts (Table 5).

Table 5: Responses on drivers of FMO

Drivers	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**Count**
Cost savings	√	√	√	√	√	√	**6/6**
Focus on core business	√	√	√	√	√	√	**6/6**
Expertise involvement	√	√	√	√	√	√	**6/6**
Risk transfer	√	√			√	√	**4/6**
Access to services and emerging technologies	√	√			√	√	**4/6**
Improve quality of services		√	√	√	√		**4/6**
Time-savings	√			√	√		**3/6**
Flexibility				√	√	√	**3/6**
Improve user satisfaction		√			√		**2/6**
Avoid major investments				√		√	**2/6**
Improve strategic positioning					√		**1/6**

In line with the literature findings, all the respondents agreed that the organisations are moving to outsourcing, in order to achieve cost savings, expertise-based higher quality and so as to focus on their core business function. R2 and R4 considered that cost savings remain as the key driver for the development of outsourcing, as the client can avoid the cost of internal staffing (e.g. welfare cost, allowances and bonus) and the uncertain material costs of work by adopting FMO.

Four out of the six respondents agreed that 'risk transfer' is a significant driver, as the client can share the risks and responsibilities related to outsourced services fully (TFM) or partially with the vendor (managing agent or managing contractor). According to R1, R4 and R5, outsourcing leads to improved responsiveness and delivery of quality services by specialist vendors in the field.

In the opinion of R5, 'improve strategic positioning' can be a driver when the organisation adopts a proper contract with clear definitions of the roles and responsibilities of the vendors and the in-house staff. R4 and R6 indicated that, when the business is growing, the temptation is to expand the facilities, staff and new businesses through outsourcing, which can avoid substantial investment in support services.

5. Conclusions

Outsourcing is a growing trend in sourcing FM services in Sri Lanka as in many other countries. In making an outsourcing decision, it is fundamental to consider challenges and drivers of FMO in achieving the best performance of FM services. This paper provided insight into both positive and negative factors influencing FMO along with some suggested strategies to overcome the identified

issues in Sri Lanka. Through the interviews with six FM experts, fourteen challenges and eleven drivers were found to be influential in the practice of FMO in Sri Lanka. Among them, cultural change, higher management overhead, conflicts of interests and poor coordination between client and vendors are significant challenges of FMO, whereas cost savings, focus on core business, expert involvement and risk transfer are the major drivers of FMO (refer Tables 3 and 5). In addition, flexibility, inexperience and lack of required skills, integrity issues and difficulty in finding the correct vendors were newly added in the list. Further, the contractual issues highlighted in the literature (refer Nos. 11-18 in Table 3) were not agreed as challenges by the respondents. Besides, this paper presented different types of basic strategies in FMO such as Managing Agent, Managing Contractor and TFM, the pros and cons of which could be assessed in selecting the optimal strategy for an organisation based on the nature of services and the terms included in contracts. This study could help to understand FMO, possible FMO strategies and influential factors affecting FMO, thus helping to make effective decisions in FMO.

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APPLICABILITY OF RECYCLED PLASTIC FOR ROAD CONSTRUCTION IN SRI LANKA

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Abstract
Even though Polymer Modified Bitumen (PMB) is being emerged as an alternative for conventional asphalt in the global context, the use of recycled plastics to produce PMB is still an unorthodox concept in Sri Lanka. Therefore, the study aimed at evaluating the applicability of recycled plastic as a construction material in road construction in Sri Lanka. The study apprehended a qualitative approach comprising a literature review, followed by twelve expert interviews. The data were analysed using manual content analysis. The economic, environmental, and social benefits and enablers along with social, technology-related, knowledge-related, economic, and resource-related barriers in implementing PMB in Sri Lanka were identified. Additionally, strategies to overcome such barriers were suggested. The study further recommends the use of recycled polymers over virgin polymers; increasing the awareness level in the industry; extending the government involvement; and establishing a standard specification.

Keywords: *Asphalt; Polymer Modified Bitumen (PMB); Recycled Plastic; Roads.*

1. Introduction

Roads are built to improve the mobility of people and connectivity and are credited with important socio-economic improvements of a country (Demenge et al. 2015). In consideration of road construction, asphalt has been used widely as a binder for aggregate in road paving (Shafii et al. 2013). The common problem with all applications that involve asphalt materials is the temperature susceptibility, as asphalt tends to become brittle at low temperatures and soft at high temperatures (García-Travé et al. 2016). To overcome such issues and to reduce damages, polymer modified asphalt has been introduced so as to prolong the service life of road pavements even with the increment of traffic volume (Shafii et al. 2013). Use of polymers, which are either virgin or polymer waste, to modify the bitumen and to use as plastic-coated aggregates are being studied to improve the performance of the pavement (Rajasekaran et al. 2013).

Plastic, which is one type among various types of polymers, and a non-biodegradable material is said to be capable of remaining on earth for about 4500 years without degradation (Awaeed et al. 2015). Sri Lanka imports 160,000 metric tons of plastic raw materials and another 100,000 metric tons of finished and intermediate products every year and most of those remain in the environment as post-consumer plastics and polythene waste causing severe environmental and health problems (Gunarathna et al. 2010). On the other hand, Sri Lanka's road network density is among the highest in Asia, as the number of road kilometres per population exceeds the related indicators of both Pakistan and Bangladesh (Road Development Authority 2007). Khan et al. (2019) reported that recycling waste plastic has been an important strategy in order to reduce the amount of plastic and polythene waste accumulated in the environment thereby minimising the environmental threat encountered.

Even though Polymer Modified Bitumen (PMB) is being used for road construction globally, Sri Lanka's experience in PMB is limited due to lack of knowledge, technology, and quality issues (Sitinamaluwa and Mampearachchi 2014). However, roads as the dominant transport infrastructure in Sri Lanka, higher attention needs to be paid to develop the Sri Lankan road network using recycled polymer mixed bitumen mixtures. The purpose of this study is, therefore, to address the literature gap and the industrial requirement pertaining to such, by evaluating the applicability of recycled plastic as a material in road construction in the Sri Lankan context. Accordingly, the paper overviews the applicability of recycled polymers to modify asphalts in pavement construction in Sri Lankan context by identifying the suitable polymer types in road construction; identifying enablers and barriers and suggesting solutions to use polymer modified asphalt in pavement construction; and determining the impact of using polymers in road constructions in terms of sustainability pillars.

2. Literature Review

2.1 POLYMER MODIFIED BITUMEN (PMB) AS A CONSTRUCTION MATERIAL

'Bitumen' is one of the oldest and widely used construction materials in civil engineering constructions (Hunter et al. 2015). Paying attention to environmental considerations, the use of alternative materials replacing traditional materials is to be incorporated in road construction (Balaguera et al. 2018). In addition, due to the restricted oil resources available to produce quality bitumen, lack of effective and functional control actions during the refinery process and the propulsion of getting the maximum economic benefits, the industry has been driven to concentrate on bitumen modification (Zhu and Kringos 2015). According to Becker et al. (2001), major reasons to modify bitumen with various typer of polymers are; to obtain softer blends at low service temperatures to reduce surface cracking; to obtain stiffer blends at much higher temperatures to reduce permanent deformation; to minimise viscosity of the mix at laying out temperatures at sites; to increase the stability and the strength of mixtures, fatigue resistance of blends, oxidation and aging resistance; to decrease structural thickness of pavements; and to decrease life cycle costs of pavements.

According to Kalantar et al. (2012), various studies have been published on the use of different types of waste polymers in road pavements, such as; Polyethylene Terephthalate (PET), Polyethylene (PE), Polyurethane (PU), Polypropylene (PP), Ethylene Vinyl Acetate (EVA), Styrene Butadiene Styrene (SBS), and Polyvinyl Chloride (PVC) etc. When it comes to the form of polymers to be used for the asphalt modifications, an interest is being emerged in using recycled polymers as the modification agent rather than virgin polymers (González et al. 2002). Since using newly formed polymers is expensive, either virgin polymer quantity that is used for modification has to be reduced or recycled polymers that show similar results in enhancing the properties in modified bitumen in comparison to virgin polymers have to be used (Kalantar et al. 2012).

2.2 BENEFITS OF USING POLYMER MODIFIED BITUMEN (PMB)

In an environmental point of view, use of recycled materials reduces the amount of plastic waste in new roads and maintenance of roads compared to virgin polymer resulting a major impact on environment (Leegwater et al. 2016). Another plus point of using recycled plastics to produce PMB is that waste plastics only melt but are not burnt during the production process, minimising the gas emissions, and diminishing the air pollution (Sangita and Kaur 2011). In an economic point of view, in terms of usage cost, achieving highest performance might not be the best option, but considering the cost effectiveness of technology and life cycle costs, society can achieve maximum benefits with comparatively higher performance of roads constructed using PMB (Zhu, B. et al. 2014). Using recycled polymers for PMB has much lower production cost compared to PMB made using virgin polymers (Leegwater et al. 2016). Bagui and Ghosh (2012) also argued that PMB is an economically and financially viable material. Similarly, in a cost analysis conducted by Souliman et al. (2016), they showed that PMB is 2.6 times cost-effective compared to conventional bitumen and that cost-effectiveness increases with the increment of vehicle speed. Therefore, it is beneficial to use PMB from both environmental and economic points of view, considering the improvement of pavement performances and as a solution to the waste disposal (González et al. 2002). Other than the benefits of using PMB, challenges of using PMB also need to be assessed when it comes to implementing PMB.

2.3 CHALLENGES OF USING POLYMER MODIFIED BITUMEN (PMB)

Since properties of PMB change with the temperature, road designers need to determine the measures of performances, whether to use PMB or not and if yes, polymer quantity to be used in the roads must also be ascertained (Zhu et al. 2014). Further, the same study shows that PMB percentages to be used in asphalt mixes vary from one country to another due to the degree of traffic and climate conditions, as well as for a given

country, it differs from one year to another. With respect to the Sri Lankan context, the study by Gunarathna et al. (2010) elaborated that plastic recycling industry has some constrains such as; limited number of wastewater treatment facilities; insufficient collection of plastics compared to the capacity of plastic recycling; lack of standard techniques in collecting and sorting plastics; complications in getting Environmental Protection License (EPL); and lack of suitable land around major cities to implement large scale plastic recycling plants, which ultimately leads to complications in implementing PMB constructions using recycled polymers in Sri Lanka.

Hence, the applicability of using PMB for road pavements in Sri Lanka needs to be assessed in terms of enablers, barriers and impacts of using PMB in the Sri Lankan context in order to provide solutions for industrial constraints of PMB implementation.

3.0 Research Method

Creswell (2014) commended the qualitative approach, as it is the most suitable, if the existing literature is not extensive or if the variables to be explored are unknown. Besides, the study apprehended a qualitative approach as it would value and encourage the free flow of ideas, opinions, perceptions, and experience of people in order to develop this conceptual idea. Accordingly, twelve (12) face-to-face expert interviews of semi-structured design were conducted with professionals such as Engineering and Quantity Surveying professions, who are having more than 15 years of experience in road construction in Sri Lanka. Literature findings were solely related to the developed and developing countries of Europe and Asia. Hence, one of the objectives of the expert interviews was to appraise the applicability of recycled plastic in Sri Lankan road construction. When observing the road construction industry, using PMB is a novel measure in the Sri Lankan context. Therefore, another objective was to evaluate the establishment of the PMB technology to Sri Lanka through the experience and the knowledge of the interviewees. The profile of the interviewees is presented in Table 1.

Table 1: Profile of Interviewees

Interviewee Code	Profession	Designation	Experience
IE1	Engineer	Senior Project Engineer	24 years
IE2	Engineer	Senior Project Engineer	17 years
IE3	Engineer	Chief Engineer	24 years
IE4	Engineer	Project Director	22 years
IE5	Engineer	Senior Project Engineer	20 years
IE6	Engineer	Senior Project Engineer	20 years
IE7	Engineer	Senior Project Engineer	15 years
IE8	Engineer	Senior Project Engineer	15 years
IE9	Quantity Surveyor	Senior Quantity Surveyor	15 years
IE10	Quantity Surveyor	Manager Contract Administrator	20 years
IE11	Quantity Surveyor	Quantity Surveyor	14 years
IE12	Quantity Surveyor	Senior Quantity Surveyor	15 years

The interviewees were selected using purposive sampling, in consideration of their knowledge of and experience in road construction in Sri Lanka, their insight and exposure in establishing new and innovative concepts related to road construction, their willingness and availability for interviewing (Etikan et al. 2016). Data were analysed manually using content analysis as it is based on

interpretations, explanations and clarifications that are obtainable from the collected data where there are no quantitative representations of the data (Boughzala et al., 2012).

4.0 Research Findings and Analysis

4.1 APPLICATION OF POLYMER MODIFIED BITUMEN (PMB) IN THE SRI LANKAN CONTEXT

Upon reviewing the importance of using PMB, it was revealed that as the porous technology is being used for most of the national and provincial roads in present, combining porous technology with PMB will be an upgrade compared to the conventional roads. Besides, being a partial solution for the environmental pollution by waste plastics, interviewees suggested that PMB will be a partial solution for the scarcity of construction materials that are used for conventional asphalt pavement constructions, specially bitumen. Another important fact highlighted by the interviewees was the increment of the durability of asphalt pavements by adding polymers. It makes a direct and indirect impact on the operational stage of the roads socially and economically. Such an enhancement would affect the qualitative factors concerning the economic dimension including, but not limited to a reduction of maintenance frequency, thereby minimising the maintenance cost. In the social dimension, the community would be benefitted by time savings due to reduced traffic, comfortable rides, etc.

Among the two polymer types that can be used to modify asphalts: virgin polymers and recycled polymers, interviewees suggested using recycled polymer to produce polymer modified asphalts over virgin polymers. The rationale of the suggestion is that recycled polymers provide a partial solution to the waste plastic problem and the scarcity of pavement construction materials in Sri Lanka. However, several interviewees argued that the inability to achieve the same purity level as virgin polymers through recycled polymers, not having a properly established waste plastic process within the country and the non-availability of waste plastics in required bulk quantities as several drawbacks in using recycled polymers over virgin polymers.

Considering the available waste plastic quantities and the types of waste plastics, a majority of the interviewees suggested to use PET, Low Density Polyethylene (LDPE) and High Density Polyethylene (HDPE) for the polymer modification of asphalts in Sri Lanka. However, proper testing and sampling is essential in using such polymer types. From both literature review and expert interviews, it was found that the use of PMB would improve the rutting resistance, fatigue resistance and stiffness of the pavement compared to conventional asphalts. Additionally, as per the interviewees, increment in bonding and flexibility of bonded particles will improve the responsiveness to the temperature and the surface irregularities resulting in a higher International Roughness Index (IRI) value.

Further, majority of interviewees highlighted that, there are no publications for identification, specification, and any assessment criterion for the application of PMB in Sri Lanka. Therefore, it was identified as an area to be improved since performance evaluation tests are needed for the purpose of establishing standards and specifications and to follow those standard. Literature findings on the performance evaluation tests for asphalt pavement construction were presented to the interviewees, who asserted that all the test methods identified through literature are available in Sri Lanka and that all the tests to be conducted for PMB are same as the conventional asphalts in Sri Lanka. Those performance evaluation tests are; Marshall Stability test, Softening point test, Penetration Index test, Flash point test, Fire point test, Viscosity test, Ductility Index test, Aggregated Impact Value test, Soundness test, Void Measurement test, Moisture Absorption test, and Los Angel's Abrasion Test.

4.2 BARRIERS IN IMPLEMENTING POLYMER MODIFIED BITUMEN (PMB) AND RESPECTIVE STRATEGIES TO OVERCOME THE BARRIERS

Barriers to implement PMB in Sri Lanka were presented under the main five (5) categories namely;

social, technological, knowledge-related, economic, and resource-related barriers. The barriers found under each category are elaborated in Table 2.

Table 2: Barriers in implementing polymer modified asphalt technology in Sri Lanka

Barrier Category	Barriers
Social Barriers	• Less awareness on PMB in Sri Lanka • Resistance to change from existing technologies
Technology-Related Barriers	• Resistance to make changes in plant and equipment • Limited number of pilot projects
Knowledge-Related Barriers	• Limited researches on using polymer PMB in Sri Lanka • Non-availability of specifications for PMB in Sri Lanka
Economic Barriers	• Less involvement of government sector • Risks of using experimental materials
Resources-Related Barriers	• Less availability of polymer types • Lower purity level of recycled polymers

Sitinamaluwa and Mampearachchi (2014) stated that lack of knowledge, technology and quality-related problems are the main barriers in implementing polymer modification of asphalts in Sri Lanka. According to the interviewees, lack of awareness on PMB technology is the main barrier for implementation in Sri Lanka. Even though this technology is upward trending other countries, the awareness of the Sri Lankan construction industry is low-lying. Besides, having no practical experiments to study the behaviours and the properties of the polymer modified pavements is another technology-related barrier, which narrows the possibilities for conducting further researches and analyses. Furthermore, as emphasised by many interviewees, the lack of recognition of application of PMB in the road industry may cause many financial problems to both RDA and contractors until the advantages or benefits over conventional asphalts in Sri Lanka are realised. On the other hand, applicability of quality-related tests concerning the reliability of suggested methods might raise doubts at the beginning with the results of applications. Interviewees further argued that less confidence level on adapting to a new technology is causing due to the human nature of less willingness to move past the current technologies. Interviewees further explained it as a cultural aspect, which is a quantifiable effect, but adversely directly impacting decision making relating to the road construction.

In order to overcome such barriers, strategies such as; increasing the awareness level through conference proceedings, workshops, Continuing Professional Development (CPD) programs etc.; involvement of the government bodies; getting foreign expertise; and conducting theoretical and experimental researches were suggested by the interviewees for the implementation of polymer modified asphalt in Sri Lanka. In addition, carrying out technical surveys on PMB would increase the awareness level besides awareness programs, workshops, and seminars. Accordingly, increasing the awareness level would open up the possibilities to resolve technical related problems and most importantly it would help the industry to understand the benefits and the advantages of the technology within road construction industry and as well, the environment. Interviewees also suggested obtaining foreign expertise, who have experience with the asphalt modification with polymer, in order to conduct awareness programs to the industry professionals and also to consult on researches and on road projects as some strategies to overcome such barriers.

4.3 ENABLERS IN IMPLEMENTING POLYMER MODIFIED BITUMEN (PMB)

According to the expert interview findings, the two major enablers to implement PMB in Sri Lanka are, availability of waste plastics to explore various polymer types to modify asphalt; and the ability to get required consultations from other countries. Even though PMB constructions are at the elementary stage in Sri Lanka in terms of implementation so far, as a result of the effective

relationships with the construction industries of other countries, opportunities have been open up to study on the technical requirements referring to their PMB projects. For an instance, since India is having the same climatic conditions and the applications of the PMB projects, analyses of their data will help to decide whether PMB technology is beneficial to carry out in Sri Lanka and to go through the implementation process. Additionally, it was highlighted that the availability of the number of polymer types to explore this polymer modification technology in Sri Lanka as an enabler to implement polymer modification of asphalts. Not having an impactful approach to resolve the environmental waste plastic issue so far is another incentive to implement PMB technology in Sri Lanka. Accordingly, as highlighted by the interviewees, analysing the available data and cost-benefit analyses from the other countries will help to realise the value of the implementation of PMB technology in Sri Lanka.

4.4 IMPACT OF USING PMB IN ROAD CONSTRUCTION IN SRI LANKA

Impact of using polymers for road construction was deduced via expert interviews based on the three pillars of sustainability and the expected status of PMB compared to conventional asphalts in Sri Lanka. Accordingly, adding polymers to the asphalt modification might escalate the initial cost depending on the level of the exposure to the asphalt modification technology, and due to the cost difference between polymer and replaceable aggregate and bitumen quantities with polymer. Nevertheless, improvement of properties of PMB will decrease the maintenance frequencies, which ultimately impact the reduction of operational costs of the roads, further resulting in the reduction of life cycle cost of the roads compared to conventional asphalts. Accordingly, it is evident that PMB based on recycled plastics facilitates long term value-creation contributing to economic sustainability. Additionally, without importing virgin polymers from other countries, the use of waste plastics would not be economical at the earlier stages of implementing PMB in Sri Lanka. However, with the adaption and evolvement of the government in using PMB, it would enhance the economic sustainability.

One option of the interviewees was to add polymers to bitumen replacing a percentage of the total bitumen volume. Another way was replacing the percentage weightage of aggregate with polymer coated granules. Either way, it is reducing the raw material content of the asphalt mixture compared to conventional asphalt mixture, providing a replacement of raw materials, which gives a positive impact on the environmental sustainability. Even if the replaceable percentage of bitumen is a smaller value, considering the Sri Lankan road construction industry and its volume of work per annum, replaceable quantity becomes larger in each year. According to the opinions of the interviewees, if the recycling processes were done keeping its required purity level of the polymers and with the work volume of road contraction per year, the use of PMB for the pavement construction in Sri Lanka would be highly sustainable. Improvement of the irregularities of the pavement surface will reduce the depreciation of the vehicles. Besides, with the increment in the lifetime of pavements and with the improvements of the properties, the number of rehabilitation and maintenance activities on the road pavements will reduce resulting less vehicular traffic on roads saving the travelling time and associated costs. On the other hand, with the involvement of many government sectors such as RDA, Central Environmental Authority (CEA), municipal councils to co-operate with the PMB concept, it will open up many social opportunities and the possibilities.

Moreover, as emphasised by many interviewees, with the establishment of PMB, the purity level of the recycled polymers has to be maintained at a higher level. For the purpose, waste plastic recycling within the country has to achieve a certain level of quality and it needs to be done according to a well-established process from the stage of waste plastic collection. This would facilitate in increasing the effectiveness of waste management in Sri Lanka creating many job opportunities. Furthermore, considering the expected exposure to PMB technology in Sri Lanka, the status of the PMB compared to conventional asphalts was analysed based on time, cost and quality parameters. Accordingly, the

study revealed that even though PMB has no noticeable impact on the construction time, substantial quality improvements along with considerable savings in construction cost could be achieved in comparison to conventional asphalts. Further, interviewees emphasised the need of revising the existing SCA/5: Standard Specifications for Construction and Maintenance of Roads and Bridges or publishing a separate specification for PMB road pavement constructions in Sri Lanka.

5.0 Conclusions and Recommendations

Asphalt being the main composite material used for the road pavement construction and with the rise of traffic load on road pavements, many shortcomings were observed, and many researchers were keen on finding solutions to overcome those shortcomings. Even though many studies were done to overcome the distresses of conventional asphalt by polymer modification in other countries, the awareness level of using polymers to improve the asphalt properties is at a minimum level in Sri Lanka. Thus, this study makes the reader aware of the gap between the exposures of the countries that use PMB and the awareness level of Sri Lanka regarding the use of PMB. The study therefore makes a useful theoretical contribution by analysing the applicability of recycled plastic as a construction material in road construction in Sri Lanka.

The findings of this study put forward PMB as a notable and experimental concept to the Sri Lankan road construction industry and the community. Thus, opportunities derived from the PMB concept can be used for the development of environmental, economic, and socio-cultural aspects in developing countries such as Sri Lanka. During the research process, limited availability of projects, which are in the testing mode, less awareness on the concept of using polymer for asphalt modification, less availability of the professionals who has both conceptual knowledge and experience on the PMB in the Sri Lankan road construction industry were the major limitations encountered. Most significantly, limited availability of the PMB used projects was a major limitation since those projects are in testing mode and 'restricted' on publishing records publicly by the authorities until the tests are completed.

It is further recommended to take necessary steps to increase the awareness of the use of polymer modified asphalt in road pavements in the Sri Lankan road construction industry. For such arrangements, involvement of the government authorities would make a considerable boost in terms of awareness level within the construction industry and the society. Additionally, approaching from the employer's standpoint rather than the contractor's standpoint is recommended to implement the PMB technology in Sri Lanka, in order to keep the competitiveness in the procurement processes. Moreover, as discussed in the study, it is recommended to fulfil the gap of establishing standard specifications for polymer modified asphalt through a revision to SCA/5: Standard Specifications for Construction and Maintenance of Roads and Bridges or publicising a separate specification for road pavement constructions in Sri Lanka.

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CONFLICTS BETWEEN ENGINEERS AND TECHNICIANS: THE CASE OF SRI LANKAN HOTEL FACILITIES' MAINTENANCE DEPARTMENTS

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Abstract
Conflicts between engineers and technicians in maintenance departments of hotels can be impacted on both individual and organizational performance either constructively or destructively. Generally, the destructive impacts of conflicts on organizational performance are severe than constructive impacts. Therefore, understanding the nature of the major conflicts between engineers and technicians in maintenance departments is significant to provide high- quality maintenance services within hotel facilities to deliver the best hospitality services to foreign and local guests. Thus, this study aimed to investigate the nature of existing major conflicts between engineers and technicians in the maintenance departments of Sri Lankan hotel facilities. A qualitative approach was adopted by using the case study research strategy (five nr of cases) and empirical data was collected via two expert interviews in each case, and document review within selected cases. Manual content analysis was used to analyze the data. The findings of this study revealed that 13 existence major conflicts between engineers and technicians in maintenance departments of Sri Lankan hotel facilities were based on seven conflict categories with comparing the literature findings.

Keywords: Conflict categories, Case studies, Content analysis, Maintenance department

1. Introduction

The hotel industry is one of the most important fast-growing sectors in the world economy (Cheng, 2018). The hotel industry provides significant contributions to the Sri Lankan economy as the third foreign exchange earning source (Sri Lanka Tourism Development Authority, 2017). The sources further state that the success of the hotel sector is depended on its occupancy level. Therefore, as a major economic sector in the Sri Lankan economy, hotel facilities must be well maintained to get attraction from both foreigners and local guests (Ambepitiya & Dharmasiri, 2017). As a result of that, the maintenance department in every hotel has a significant role to achieve the success of the hotel industry (Ejikeme, et al., 2016).

Quality of the maintenance services in the hotel industry depends on the quality of the services of the employees because employees are considered as the backbone of every organisation and department (Ratnayake, et al., 2013). According to Lai (2012), teamwork always affects to enhance the quality services of employees in the maintenance department of hotel facilities. Furthermore, engineers and technicians are major professions that represent the maintenance team in the hotel industry (Ghazi, 2016). However, when working as a team, arising of conflicts is obvious between engineers and technicians because everybody may not defend and accept similar feelings, beliefs, preferences, thoughts, and attitudes, etc. (Yusuf & Anuar, 2014). Thus, a conflict can be defined as “disagreement in opinions between people or group, due to differences in attitudes, beliefs, values or needs” (Thomas, 1992).

Conflicts between the engineers and technicians can create numerous destructive impacts as well as some constructive impacts on the performance of the maintenance department and the performance of the whole hotel industry. Destructive impacts lead to; Create industrial conflicts and disputes, Creating employee' job dissatisfaction, Delaying of maintenance works (it might be caused even to create unhappy customers), Consume additional costs and time, Creating requirements for legal advice, and increased turnover of maintenance staff, etc. (Chigozie, 2017; Hon & Chan, 2013). Whilst constructive impacts can also be there since different perspectives can add novel approaches and innovation to workplace practices. These destructive impacts can be eliminated and understanding the nature of major conflicts between engineers and technicians in the maintenance department of the hotel industry can be the essential first step (Dann & Hornsey, 1986). Therefore, this study is focused

to investigate the nature of major conflicts between engineers and technicians in the maintenance departments of Sri Lankan hotel facilities.

2. Literature Review

2.1 SIGNIFICANCE OF UNDERSTANDING THE NATURE OF MAJOR CONFLICTS BETWEEN ENGINEERS AND TECHNICIANS

The nature of the jobs of maintenance employees in the Sri Lankan hotel sector is complex when compared to other countries (Ambepitiya & Dharmasiri, 2017). As a result of that, several conflicts arose between the staff members in the maintenance departments during the working period (Yusuf & Anuar, 2014). Nowadays, most of the conflicts are arisen between the engineers and technicians, because engineers are considered as managerial staff and technicians are considered as non-managerial staff in the Sri Lankan hotel industry (Ambepitiya & Dharmasiri, 2017). The two parties gain different benefits from the organization as of their job level (Hon & Chan, 2013). However, the success of maintenance services is highly dependent on both of the parties' performances (Lai, 2012). Moreover, there is an experience and knowledge gap between the engineers and technician's integration in the Sri Lankan hotel industry. As a result of that, arising of conflicts between the engineers and technicians can be considered as a common issue in the Sri Lankan hotel industry. As mentioned in the introduction, it can destructively affect the development of the Sri Lankan hotel industry.

However, in the first place, there is a lack of attention paid towards understanding the nature of those conflicts between the engineers and technicians in the Sri Lankan hotel industry, because of management of the Sri Lankan hotel sector has not properly weighed the significance of conflict management processes. It can be happened due to insufficient research on conflicts between the engineers and technicians in the Sri Lankan hotel industry.

2.2 ENGINEER'S JOB ROLE IN THE MAINTENANCE DEPARTMENT OF HOTEL FACILITY: AN OVERVIEW

According to Mishra and Pathak (2012), maintenance engineering can be defined as disciplines and vocation of relating to engineering approaches for the optimization of systems, equipment, maintenance costs, and procedures to ensure better availability, maintainability, and reliability of equipment and systems of the facility. The persons, who do the maintenance engineering practices can be called as maintenance engineers (Mishra & Pathak, 2012). Maintenance engineers are managerial employees in organizations (Niebel, 1994). Furthermore, maintenance engineers are key persons, who have responsibilities in the maintenance department and all the employees of the maintenance department should be reported to the maintenance engineers (Muchiri, et al., 2011). Every maintenance engineer has the responsibility to carry out maintenance works of the hotel facility as planned to achieve maintenance standards (Lai, 2012). The number of maintenance engineers in the maintenance department of the hotel facility depends on the different factors such as the scope of maintenance works, nature of the hotel, size of the hotel, numbers of building services, organization structure and financial ability, etc. (Ghazi, 2016). For example, some hotels are recruited separate maintenance engineers for separate building services such as; electrical engineers, building work engineers, etc., and all engineers perform under the supervision of chief maintenance engineers (Lai & Yik, 2012). Nevertheless, some hotels have recruited a single maintenance engineer to coordinate all the maintenance works of the hotel facility (Chan, et al., 2001).

2.3 TECHNICIAN'S JOB ROLE IN THE MAINTENANCE DEPARTMENT OF HOTEL FACILITY: AN OVERVIEW

Technicians can be defined as persons, who have responsibilities for performing extremely differentiated tasks to install, maintain, troubleshoot, and repair the facility, systems, and equipment according to maintenance and safety standards to achieve better availability, maintainability, and reliability of equipment and systems of the facility (Stevenson, 1970). Most of the hotels are recruited separate technical staff to maintain the separate building service (Lai, 2012). Because, a technician is a person, who has specialized knowledge and experience in relevant building service (Stevenson, 1970). Accordingly, there are several technicians involved to carry out maintenance works related to building services in hotel facilities under different job titles such as; HVAC technicians, electricians, plumbers, building work technicians and general technicians, etc. (Chan, et al., 2001). According to Borsenik (1977), the number of technicians in the maintenance department is depended on several factors such as; the scope of maintenance works, nature of the hotel, size of the hotel, numbers of building services, organization structure, and financial ability, etc.

In most of the hotel facilities, technicians are considered as non-executive or non-managerial employees in the organization based on the organizational structure (Niebel, 1994). Therefore, technicians always reported to supervisors and engineers (Baum, 2002). However, technicians are the persons who perform the actual tasks and they have a better practical understanding of the maintenance of systems in the hotel facility than other staff members of the maintenance department (Trevelyan, 2007). Technicians provide 24 hours services to maintain different services in the hotel facility and they work on a shift basis (Yik & Lai, 2005). As a result of that, technicians have become a key role in the hotel facility, and the hotel cannot be maintained without the support or employment of the technicians (Stevenson, 1970).

Reviewing both the roles; engineer and technician, in the maintenance department of the hotel, simply engineer can be considered as the person, who has advanced theatrical knowledge of maintenance works in the facility (Mishra & Pathak, 2012) whereas a technician can be considered as the person, who has advanced practical knowledge and experience about maintenance works of the particular facility (Trevelyan, 2007). Furthermore, it can be implied as the engineer is a person, who gives advice and opinions to carry out maintenance activities (Muchiri, et al., 2011) whereas the technician is a person, who performs hotel maintenance tasks and activities (Yik & Lai, 2005). Therefore, both engineer's and technician's work are essential to enhance the quality of services within the maintenance team of a hotel facility.

2.4 MAJOR CONFLICTS BETWEEN THE ENGINEERS AND TECHNICIANS IN THE MAINTENANCE DEPARTMENT OF HOTEL FACILITY

Most of the organizations encourage teamwork within their organizations, especially in the hotel industry. A maintenance department of a hotel facility should work as a team (Monica Hu, et al., 2009). When working as a team, internal conflicts between the team members cannot be avoided. Conflict is an outcome of human behaviors' and it is becoming an integral part of employee life (Yirik, et al., 2015).

'Conflicts' have been investigated over the past ten decades by many researchers and great minds. In there, most of the researchers have attempted to define the 'conflict' in their ways. Simply, conflicts can be defined as the situation in which one person or party proposes that its benefits are being disparate or opposed by another person or party (Jehn & Bendersky, 2003). Therefore, a conflict is a "disagreement in opinions between people or group, due to differences in attitudes, beliefs, values or

needs" (Thomas, 1992, p. 265). A dynamic situation that happens between independent persons or parties as they perceived adverse emotional responses as a result of disagreements and arguments with the achievement of their goals also can be called as a conflict (Omisore & Abiodun, 2014). According to Jehn and Bendersky (2003), conflict refers to the differential or discrepant views between the parties who are involved to work. Conflicts are directed to human minds to create negative emotions and feelings. According to that, the main seven types of conflicts between engineers and technicians in the maintenance department of the hotel facility can be identified (Yusuf & Anuar, 2014) as Table 1;

Table 1: Types of conflicts

Type of Conflict	Description	References
Conflicts of relationships	Disagreement about interpersonal incompatibilities among engineers and technicians	(Yusuf & Anuar, 2014)
Conflicts of cultural differences	Disagreement about cultural believes between engineer and technician	(Isa, 2015)
Conflicts of harassment, Bullying, and Discrimination	This type of conflict may affect the physical and mental health of employees	(Isa, 2015)
Conflicts of performance differences	Disagreement about the quality of the employee's services. When the technician did not comply with the quality level that is expected by an engineer, conflict may arise between the engineer and the technician	(Yusuf & Anuar, 2014)
Conflicts of unclear responsibilities	When it is unclear who is responsible for what works in an organisation, conflicts may occur	(Tjosvold, 2008)
Conflicts of the process	A process conflict can be defined as a disagreement over the methods and procedures that can be used to accomplish a task. To be more specific, a process conflict will be associated with the allocation of resources; and duties, and responsibilities to different people to accomplish a task	(Tjosvold, 2008)
Conflicts of tasks	A task conflict can be defined as a disagreement among group members or individuals about their decisions, viewpoints, ideas, and opinions. As examples of task conflict are disagreements about the content of tasks and occupant goals such as the distribution of resources, interpretation of facts, and operation procedures.	(Poole, et al., 1991)

Most of the past researchers have considered the above seven types of conflicts mentioned, as the main categories of conflicts between the engineers and technicians in the maintenance department of the hotel industry throughout the world.

3. Research Method

A systematic framework that describes the way to accomplish the research aim and objectives can be called as a research methodology (Fellows & Liu, 2008). The appropriate research approach is depended on the research question. The research problem can be elaborated on different types of questions namely what, why, who, where, and how (Yin, 2009). Commonly, five different types of research approaches can be adopted in research: experiment, survey, archival analysis, case study, and history (Rowley, 2002). To identify the major conflicts between the engineers and technicians in the maintenance department, the behavioral nature of the engineers and technicians had to be studied.

Therefore, a case study based qualitative research approach was selected for the study. According to Yin (2009), the number of cases in a case study could vary from one to eight depending on the nature of the study. For this study, five main five star hotels in Colombo, Sri Lanka, which had approximately similar hospitality services and facilities to local and foreign guests, were selected. The data required were collected using semi-structured interviews. The interviews were selected as the data collection method to abstract data from real-life scenarios from the concerned main perspectives of the research. The key professionals who involve managing conflicts between the engineers and technicians in selected cases were interviewed and the data collected were analyzed through cross-case analysis via content analysis. Table 2 below presents the details of the five cases and the details of the professionals who were interviewed.

Table 2: Details of the participants for interviews

Interviewee code (IC)	Designation	Location of work	Year of experience
Case A			
IC-A-01	Human Resource Manager	HR Department	15 years
IC-A-02	Engineer	Engineering Department	8 years
Case B			
IC-B-01	Human Resource Manager	HR Department	7 years
IC-B-02	Engineer	Engineering Department	10 years
Case C			
IC-C-01	Human Resource Manager	HR Department	7 years
IC-C-02	Engineer	Engineering Department	6 years
Case D			
IC-D-01	Human Resource Manager	HR Department	5 years
IC-D-02	Engineer	Engineering Department	10 years
Case E			
IC-E-01	Human Resource Manager	HR Department	5 years
IC-E-02	Engineer	Engineering Department	9 years

4. Research Findings and Discussion

The research findings are discussed under two categories: applicability of conflict categories to the maintenance department in Sri Lankan hotel facilities, and existing major conflicts between engineers and technicians based on applicable conflict categories.

4.1 APPLICABILITY OF CONFLICT CATEGORIES TO THE MAINTENANCE DEPARTMENT IN THE SRI LANKAN HOTEL INDUSTRY

As a result of the literature findings of this study, seven main categories of conflicts between the engineers and technicians in the maintenance department were found out. Through the semi-structured interviews conducted with the person from the human resource management department who engages in selected cases for conflict management, the applicability of seven categories of

conflicts in the Sri Lankan hotel industry was determined. The collected data from respondents of selected cases on the applicability of categories of conflicts are shown in Table 3.

Table 3: Applicability of conflict categories to the maintenance department of Sri Lankan hotel facilities

Conflict Category / Respondents	Applicability of Conflict Categories in Selected Cases					Comments
	IC-A-01	IC-B-01	IC-C-01	IC-D-01	IC-E-01	
Conflicts of relationships	✓	✓	✓	✓	✓	All participant believed disagreement arise based on their working relations and conflicts also happened due to cultural differences
Conflicts of cultural differences	✓	✓	✓	✓	✓	
Conflicts of harassment, bullying, and discrimination		✓		✓	✓	Participants in Case A & C believed there are no conflicts based on this category, however other argued that statement when mentioning its applicability
Conflicts of performance differences	✓	✓	✓	✓	✓	As a key category, the applicability of conflict of performance differences was accepted by all participants
Conflicts of unclear responsibilities		✓	✓	✓	✓	Participant in Case A did not believe there is unclear responsibility
Conflicts of process	✓	✓	✓	✓	✓	Most of the interviewee's suggested merging these conflict categories as one category due to their similar characteristics
Conflicts of tasks			✓			
Other Conflicts of benefits gain	✓	✓	✓		✓	Apart from Case D, this was mentioned as a conflict in all other cases
Conflicts of common resource allocation & sharing	✓		✓	✓		The majority of participants believed common resources allocation and their sharing are affected to arise conflict

Besides seven main conflict categories that were found out from the past studies such as (Isa, 2015) ; (Jehn & Bendersky, 2003); (Tjosvold, 2008); (Yirik, et al., 2015); (Yusuf & Anuar, 2014), two main categories were added by the respondents in selected cases i.e. conflicts of benefits gain and conflicts of common resource allocation and sharing. Furthermore, among the respondents, IC-A-01, IC-B-01, IC-D-01, and IC-E-01 mentioned that conflicts of process and conflicts of tasks have similar characteristics based on sources and impacts of them. Therefore, both conflicts of process and conflicts of tasks can be considered as applicable to one category of conflict between engineers and technicians in maintenance departments in the Sri Lankan hotel industry. Yet, IC-C-01 disagreed with that, mentioned both conflicts of process and conflicts of tasks have occurred between engineers and

technicians in the Sri Lankan hotel industry separately. However, based on the findings from the majority of participants, as a summary of the applicability of conflict categories to the maintenance department in the Sri Lankan hotel industry, conflicts are arising between engineers and technicians in the maintenance department of Sri Lankan hotel industry based on eight main conflict categories i.e. i) Conflicts of relationships, ii) Conflicts of cultural differences, iii) Conflicts of performance differences, iv) Conflicts of process or conflicts of tasks, v) Conflicts of unclear responsibility, vi) Conflicts of benefits gain, vii) Conflicts of harassment, bullying, and discrimination, and viii) conflicts of common resource allocation and sharing.

4.2 EXISTING MAJOR CONFLICTS BETWEEN THE ENGINEERS AND TECHNICIANS IN MAINTENANCE DEPARTMENTS OF THE SRI LANKAN HOTEL INDUSTRY

Based on eight main conflict categories, the findings of this study revealed major conflicts between engineers and technicians in the maintenance department of the Sri Lankan hotel industry as given in Table 4.

Table 4: Existing major conflicts between engineers and technicians

TYPE OF CONFLICT	MAJOR CONFLICTS	CASE A		CASE B		CASE C		CASE D		CASE E	
		IC-A-01	IC-A-02	IC-B-01	IC-B-02	IC-C-01	IC-C-02	IC-D-01	IC-D-02	IC-E-01	IC-E-02
CONFLICT OF RELATIONSHIP	Conflicts between non-experience engineers & experienced technicians	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Conflicts between new employee engineers & old technicians in hotel			✓	✓		✓			✓	✓
	Conflicts between female engineers & male technicians	✓	✓			✓	✓	✓	✓		
CONFLICT OF CULTURAL DIFFERENCES	Conflicts on cultural beliefs	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Conflicts on cultural thoughts	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CONFLICT OF PERFORMANCE DIFFERENCES	Conflicts between the engineer's performance target setting and the technician's performance target settings	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Conflicts on working quality of technicians	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Conflicts on engineer's	✓	✓			✓	✓	✓	✓	✓	✓

	performance appraisal methods and technician's performance appraisal methods										
CONFLICT OF PROCESS OR CONFLICT OF TASKS	Conflicts on task orientation between engineers and technicians		✓	✓	✓	✓	✓		✓	✓	✓
	Conflicts on operation procedures to the fulfillment of tasks					✓	✓	✓	✓	✓	✓
	Conflicts on resource allocation to perform engineer's tasks and technician's tasks	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CONFLICT OF UNCLEAR RESPONSIBILITY	Conflicts on undefined engineer's responsibilities and undefined technician's responsibilities	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Conflicts on common responsibilities between engineers and technicians	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Conflicts on hidden responsibilities of engineers and technicians	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CONFLICT OF BENEFIT GAIN	Conflicts on engineer's salary and technician's salary	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Conflicts on engineer's welfare facilities and technician's welfare facilities			✓	✓			✓	✓	✓	✓
	Conflicts on engineer's service-intensive and technician's service-intensive	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
HARASSMENT, BULLYING, AND	Conflicts on harassment between engineers and technicians										
	Conflicts on bullying	✓		✓	✓	✓		✓			

	between engineers and technicians										
	Conflicts on discrimination between engineers and technicians	✓	✓		✓		✓			✓	
CONFLICTS OF COMMON RESOURCE ALLOCATION AND SHARING	Conflicts on common resource distribution between engineers and technicians	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Conflicts on common resource sharing between engineers and technicians	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

According to Table 4, three major conflicts were revealed by the participants for the interviews. However, among these conflicts, findings revealed that conflicts between non-experience engineers and experienced technicians are major conflicts among all selected cases. All the participants believed that they were adversely affected by the performance of the maintenance department. Moreover, both conflicts that were determined based on cultural differences as Table 4 were found out from all selected cases. Case study findings also revealed that conflicts between engineer's performance target setting and technician's performance target settings and conflicts on the working quality of technicians are major conflicts based on the conflict of performance differences category in all selected cases. Conflicts on resource allocation to perform engineer's tasks and technician's tasks are the main conflict between engineers and technicians under the conflict of process or tasks category. Because technicians always complain they have not adequate resources to perform their tasks yet engineers have over resources with comparing the engineer's tasks. Also, technicians believe there is fluctuation when distributing the resources between engineers and technicians in the maintenance department of the Sri Lankan hotel industry. All the conflicts that were found out based on conflict of unclear responsibility can be considered as major conflicts because all participants in selected cases believed these conflicts are arising their facilities. Conflicts on engineer's salary and technician's salary and conflicts on service-intensive and technician's service intensive. Because of technicians were not satisfied with their salary and service intensives because they believed engineers have more salary and service-intensive than their performance and responsibilities.

Respondents in selected cases mentioned conflicts have not been arisen due to harassment between engineers and technicians in the maintenance department in the Sri Lankan hotel industry. However, literature findings were found out conflicts create due to harassment whereas through the observation in a selected case, verbal harassments were determined. Nevertheless, all the respondents in selected cases have not mentioned any harassment in their hotel facilities. However, IC-A-01, IC-B-01, IC-B-02, IC-C-01, and IC-D-01 mentioned conflicts on bullying between engineers and technicians can be determined under conflicts of harassment, bullying, and discrimination whereas IC-A-01, IC-A-02, IC-B-02, IC-D-02, and IC-E-01 mentioned conflicts on discrimination between engineers and technicians also can be determined under conflicts of harassment, bullying, and discrimination. Conflicts on common resource distribution between engineers and technicians and conflicts on common resource sharing between engineers and technicians are the main conflicts in selected five cases based on respondents. Because all the respondents mentioned both of these conflicts are arising between engineers and technicians in the maintenance department of the Sri Lankan hotel industry. Always

technicians complained engineers have more benefits when distribute and share the common resources. As a result of that, conflicts are arising between them.

According to the above findings of case studies, 22 conflicts between engineers and technicians in the maintenance department of the Sri Lankan hotel industry were revealed whereas 13 conflicts were determined as major conflicts between engineers and technicians in the maintenance department of Sri Lankan hotel industry based on their applicability to all selected cases and degree of occurrences in all selected cases (refer Table 3). In addition to that, eight conflicts were revealed by the participants as conflicts between engineers and technicians in the maintenance department of the Sri Lankan hotel industry. Nevertheless, conflict on harassment was not revealed as conflicts between engineers and technicians in the maintenance department of the Sri Lankan hotel industry due to its absence in all selected cases. These findings are useful to manage conflicts between engineers and technicians in the maintenance department of the Sri Lankan hotel industry to achieve better quality maintenance services from the departments.

5.0 Conclusion

This study focused on investigating major conflicts between engineers and technicians in the maintenance department of the Sri Lankan hotel industry. There are seven main conflicts between the engineers and technicians in the maintenance department were found out through the literature review such as conflicts of relationships, conflicts of cultural differences, conflicts of harassment, bullying, and discrimination, conflicts of performance differences, conflicts of unclear responsibilities, conflicts of process and conflicts of tasks. These conflict categories were validated by the respondents of semi-structured interviews. As per the findings of case studies, seven categories changed into eight categories. Because of conflicts of benefits gain and conflicts of common resource allocation and sharing were added by the participants in case studies apart from the conflicts that were identified in the literature review whereas case study participants suggested merging the process conflict and task conflict due to their similar characteristics. Conflicts of process and conflicts of tasks were determined as separately in the literature review. Yet, it was merged as conflicts of process or tasks by the respondents. Also, conflicts of benefits gain and conflicts of common resource allocation and sharing are added by the respondents of semi-structured interviews in five selected cases. Furthermore, 22 conflicts were found out from case studies based on the above eight main categories. At the end of data analysis, 13 conflicts were determined as major conflicts between engineers and technicians in the maintenance department of the Sri Lankan hotel industry. These findings useful to implement proper conflict management systems within the Sri Lankan hotel industry whereas findings encourage to carry out the future researches based on different categories of conflicts between engineers and technicians in the maintenance department of the Sri Lankan hotel industry.

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ANALYSIS OF HISTORICAL DATA TO DETERMINE EARLY SRI LANKAN PRINT TECHNOLOGIES

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Abstract
This research discusses the importance of historical research as it serves to determine ideas and helps to group historical facts into explanatory scientific systems. Thus, by systematically documenting this knowledge contributes to develop and improve the theory and practice of education. Since design education in Sri Lankan is nearly two decades old, subject areas such as Graphic design lacks the needed literature on early Sri Lankan graphic practices that determine and contribute towards clarifying current and future trends built on historical research. The historical data that contributes to these subject areas are found at archival locations, and the preservation process in such locations limits us from the opportunity to observe historical data (primary data); that is required to establish new knowledge; in this case graphic design.

Thus, this research aims towards documenting historical data towards building new knowledge. To achieve this, the historical data: specific to early book cover prints are compared with a literature survey on early printing technologies and on how they are identified. For this, the primary data (early book covers) from archival locations, were documented and visually observed with the use of a linen-prover magnifying glass with x4 enlarging capacity. The findings were compared with literature on different print technologies used during this era with the knowledge on how to identify them. The findings were compiled into stimuli for the analysis purpose. And finally, the gathered data was chronologically compiled as new knowledge.

In conclusion, we were able to determine the technology used in early prints, more specific to print technology used during the early book publishing and printing industry of Sri Lanka. Since the data is chronologically (1870-1920) compiled we were able to identify patterns that help build new knowledge into other subject areas. It opens up discussion on historical trends in book cover designs, parameters of each technology used in Sri Lanka that influence book layout, its typography and letter composition for further research.

Keywords: *Historical research, Book Cover design, Identifying Prints, Sri Lankan Graphic History*

1. Background and context

Historical research investigates, identifies and extracts optimal solutions to contemporary problems from the past time, and clarifies current and future global trends. Therefore by recording historical-data and by adopting historical research helps understand how our current education system was created and evolved and, on how this kind of knowledge can provide a solid foundation for further progress or change in the domain (Albulescu, 2018); In this case the domain of Design Education. The subject of typography is studied within the field of Graphic design and within this subject, we see the practice of collecting, observation and analysis of historical data (early print specimens), that had contributed towards building new knowledge: type classification theories. Classifying of typeface helps typographers and graphic designers just as plants need to be described and classified by botanists, in a universally accepted terminology (McLean,1980). The use of classification systems helps to fulfil a theoretical need and it also works as a pragmatic search function (Pohlen, 2010). These theories are based on the chronological order, or on the differences in form, tool, hand etc. Nevertheless, new classifications are built on a regular basis within the Latin Script but it is not the same with Sinhala Script/ Sinhala Typography discussed within the field of Graphic Design.

Graphic design is a diverse field of study that includes many fields such as illustration techniques, packaging design, brand identity design, layout design, and typography. Within this field, we see the influence of technology over centuries that discusses graphic design movements and styles due to social, cultural, and political change. Steven Heller and Seymour Chwast describe the appearance of visual styles in history with the influences of technology focusing on the industrial revolution and industrialisation (1994). Famous books by Phil Meggs '*A History of Graphic Design*'(1983), Craig and Barton's book *Thirty Centuries of Graphic Design* (1987) explores the effect of technical and stylistic modifiers on graphic design and typography due to social, political, and cultural changes through a historical lens. Thus the exploration of historical data contributes to the practice and theories on

Graphic Design. And one that cannot neglect the technological changes within history. For example, the subject of typography is birthed with the invention of moveable type and the printing press in 1450. In comparison to natural science, this field is rather new and to Sri Lanka it can be considered very recent.

Sri Lanka records the introduction of the printing press to the Island in 1737 by the Dutch. Until it was taken over by the British in 1796. During the Dutch administration we record that printing was limited to pamphlets, bibles, and books towards achieving their objective of evangelization (Kularatne, 2006 & Samarawckrama, 2016). The growth and the variety of printing and print materials started to appear during the British period (1796-1948). It was during this time Sri Lanka was experiencing the arrival of several missionaries who had their own printing presses, resulting with a large number of printing presses in the Island. It was also during this period we experience the next turning point in relation to printing: the Buddhist revival (1860's), As part of the social and political change most printing presses were in the hands of the locals. This change resulted in a large number of newspapers, books, posters, pamphlets in circulation within the Island.

Today, most of these early prints are lost and the remaining are catalogued in archival locations such as British Museum, Colombo Museum Library, Department of the National Archives, National Library, Royal Asiatic Society Library, Sri Lanka etc. Therefore, to gather historical data such as type specimens, early typographic designs, graphic design layouts, book cover designs we need to access these primary data at these locations. By observing such data, we will be able to contribute towards a new understanding of the past and will highlight its relevance in shaping our present and future (Cohen, Manion and Morrison, 2000).

2. Early books at archival locations

To investigate past events in this case earliest books in a systematic way, is to identify a location where historical data is systematically stored; the National Museum Library of Colombo. Here the earliest printed books are located in a shelf dedicated as the 'shelf with the oldest books'. The books in this shelf are not chronologically placed but cataloged alphabetically. Unless you know the titles of these books, they are rarely referred to by readers. In general, the publications date back to the early 18th century, and they clearly show the growth of the publishing industry in Sri Lanka. The books range from 1870 to 1980 With most published in Sinhala, and the covers range from single color to multi colors proving the use of different printing technologies.

2.1 HOW BOOKS ARE PRESERVED:

Image 01, samples of book cover design *(Source: Colombo national museum library)*

One of the notable factors when observing this shelf was that most books are in a usable condition as they are re-bound with an additional cover for protection. During this preservation process it was evident that the book covers are replaced with a plain cover board to preserve the content of the book. Thus, the original cover of the book is replaced resulting with a loss of historical data. In this case the early book cover (graphics layouts), its styles, practices, and the print technology used to produce these covers. We believe by observing these book covers and determining the technologies used to print them would help to document the early print practices that were commonly used within the book publishing industry of Sri Lanka.

2.2 THE ERA

According to Samarawickrama's research on the development of the printing press within the Island, the above-mentioned books fall into the *Early newspaper era (*1860-1980*)*. As it records the start of the first newspaper and stops towards the latter part of the letterpress printing era. From the political point of view, this era documents the growth of Sri Lanka as an independent nation. It further describes the rising movement of nationalization of the printing press. From a print technology point of view, it was the era that experienced woodcuts, wood engravings, metal relief and phototypesetting within the Island. It documents the transition from hot metal to phototypesetting.

2.3 THE BOOK AND ITS COVERS

A printed book includes several anatomical features. The book jacket is the outer cover of the book. It protects the book cover from dust and damages. The set of internal pages is called a book block, which includes the content of the book. The book spine is where the papers are bound as a block. There are few other anatomical features, such as headband, tail band. The front cover is the first of the components of the book anatomy. It includes the necessary information about the book, including title, author's name, etc. It also gives the feel of the content using graphics, images, layout, illustrations, letterings, and many other graphic elements (Gallagher, 2015). Even if the bookbinding technology and process have changed over time, this basic structure of the book has remained the same, but what has changed over time is the cover due to the change of print technologies. Therefore, this research is focused on the cover of the book to determine its technology.

2.4 IMPORTANCE OF TECHNOLOGY IN HISTORY

Technology causes innovation in every aspect of society. It can be defined as the application of scientific knowledge for practical purposes, especially in industry. It is also defined as "Simply a body of knowledge about techniques" (Freeman, 1982). Technology is capable of changing almost everything in society. " Technology is…integrated into the lives of human beings; technologies of every conceivable kind are used everywhere by human beings in order to provide food, shelter, transportation and all other basic material appurtenances of life" (Baark and Svedin, 1988). Thus, we are able to identify certain time periods based on the technology used.

The more a society is aware of the history of technology, the more adaptable a society can become (Mesthene, 1970). Understanding the impact of technology on a particular subject area throughout history contributes to establishing a subject by creating a solid foundation. It can also formulate new ideas for further inventions (Graham, 1992). Technological advancements provide new opportunities to create new tools. Therefore, whatever the subject area that uses these tools can create opportunities to achieve new goals in each individual's creations. Mesthene elaborates this idea in his comment, "A new invention or technological development- a new tool, in short- generally creates a new opportunity, either to do something differently or better than before, or to do something for the first

time that simply was not possible at all before" (Mesthene 1970). New tools can be found within history in almost all subject areas such as medicine, geography, astrology, information technology, architecture, art, design, etc. in this case we focus on printing technology used in Graphic Design , discussed under the domain of Design and Design Education.

3. Identifying print technologies

Three main categories of printing technologies can be found in historical studies. Printing is defined as transferring of ink to a prepared printing surface/ paper or other material. There are three possible ways of transferring ink. If the ink is carried on a raised surface it is called 'Relief Printing'. The second method carries the ink in a lowered groove and the transferring of this ink is called 'Intaglio printing'. The third method is called "Planographic Printing" where the ink is carried on the surface (Gascoigne, 1995).

Inside every category, there are two subcategories. The first category is manual prints. When the artist or craftsman has worked out, the final printing surface is called a manual print, and if not, it is called a processed print. Processed print techniques are usually involved with photography. Therefore, as an example, there are manual relief printing methods and processed printing relief methods. Printing techniques used within this era can be tabulated as below.

Table 01, Print Technologies

	PRINTING TECHNOLOGY		
	RELIEF PRINTING	INTAGLIO PRINTING	PLANOGRAPHIC PRINTING
Manual Printing	Woodcut	Engraving	Lithographs
	Wood engraving	Etching	Transfer Lithographs
	Metal relief prints	Dry points	
	Modern relief printing	Line Engraving	
		Steel Engraving	
		Crayon Manner Engraving	
		Soft Ground Etching	
		Mezzotints	
		Aqua Tints	
Processed Printing	Line blocks	Nature Prints	Collotypes
	Relief Halftones	Photogalvanographs	Photolithographs
		Line Photogravures	
		Tone Photogravures	
		Gravures	

3.1 RELIEF PRINTING

The oldest and simplest printing method among these is relief printing. The ink is transferred to a paper from the printing surface under pressure. This method is similar to present-day rubber stamps. Usually a block is made with hard materials like wood, and it is called as the relief block. The ink is then applied to this surface by dabbing, only to the raised parts of the blocks. Then the ink is transferred to the paper by pressing on it.

This printing process leaves certain evidence on the printed material. The pressure leaves an embossed mark on the other side of the paper, which can be felt with the tip of the finger. It further

causes an ink squashed effect and a rim around effect of ink on the paper. Six types of relief printing methods can be listed under the relief printing method, including woodcut printing, as the most common method. Each printing method holds an identical set of characteristics, including above mentioned common relief characteristics.

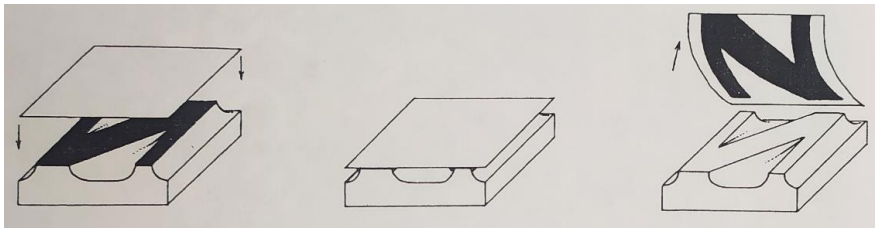

Image 02, Stages of relief printing *(Source: Gascoigne B)*

3.2 INTAGLIO PRINTING

In this method, A paper was placed on a prepared printing surface and transferred the ink from the printing surface to paper. However, it is similar to relief printing but differs from the making of the printing surface. Unlike in the relief method, the image has been achieved by the recessed areas below the flat surface of a metal plate. These recesses have been manually cut away from the plate with an engraving tool. The ink was first applied to these recesses, grooves, and transfer to the paper with great pressure. In processed intaglio printing methods, the image on the metal plate could be achieved by photographs, and the rest of the process was the same.

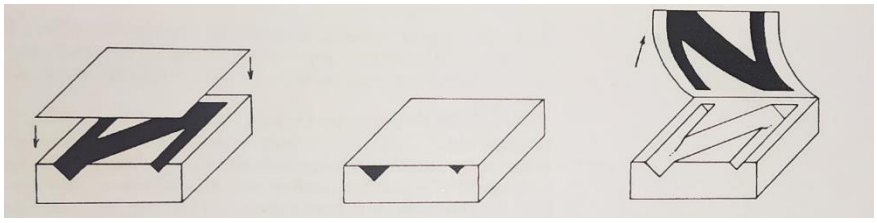

Image 03, Stages of intaglio printing *(Source: Gascoigne B)*

In an intaglio print, the lines can be darker or lighter and thinner and thicker due to the grooves' uneven depths that hold different amounts of ink. This pressure was greater than the pressure in a relief method. Therefore, it leaves an identical plate mark on the paper. Intaglio methods can achieve greater physical depth in ink and images with perfectly straight edges and unbroken lines. Furthermore, these darker lines often appear as visible ridges of ink. These identical features help to identify an intaglio print. There are fourteen different intaglio printing methods with a set of identical features for each method.

3.3 PLANOGRAPHIC PRINTING

This is the most recent method of all three printing methods. Opposed to a raised surface or a surface with grooves, this method uses a flat surface to hold the ink. The image has been created on a lithographic stone in the form of greasy marks. A chemical process serves to make these marks fully receptive to grease and full resistance to water. Then a rolled charged with ink passed over the surface. The ink was only transferred to the stone whenever it encounters grease. The next step was to apply this ink on the paper. A paper was laid on the stone with sufficient backing material above it. The downward pressure on the stone transfers the ink from stone to paper.

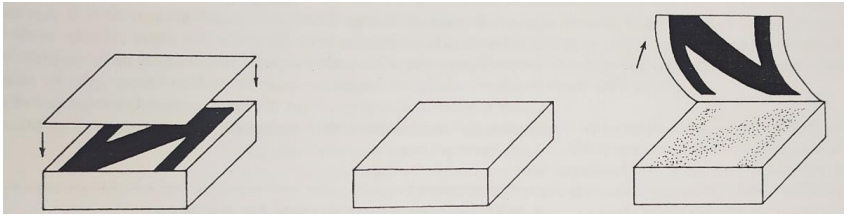

Image 04, Stages of planographic printing *(Source: Gascoigne B)*

The ink either adheres fully to the printing surface or fully rejected by it. Therefore, it has the evenness of tone and, as a result, the flatness of the image: the original and the most usual form of planographic printing. There are four types of planographic printing methods, including processed planographic methods, which involve photography in the process. Each of these planographic methods has its own set of identical features, including common planographic printing features.

4. Methodology

The methodology was conducted under four stages. The first stage was collecting data samples, second was compiling literature data on how to identify print technique into stimuli. The third stage was the summing up of the samples observed based on the knowledge gained in stage two (identifying print technologies) and the fourth stage analyzed and categorized data across a timeline. The details of these stages are as follows:

4.1 COLLECTION OF PRIMARY DATA/ SAMPLES

The collection of primary data was gathered from The National Museum Library, Colombo. It is the first legal deposit library in Sri Lanka, which owns a valuable collection of historical materials, including manuscripts, rare books, and donations of private book collections. It also records over 12 million book titles, including the shelf dedicated to the oldest published books in Sri Lanka, ranging from 1870 to 1925. This shelf included nearly 1500 Books. For this research, books with original Sinhala book covers published in Sri Lanka were selected as primary data. A total of 400 book covers were taken in for this research using the random sampling method.

All the samples were then tabulated with the title of the book, author's name, publisher's name, place, and date, including its physical dimensions such as the width, height, and thickness. The samples were then scanned at 600dpi for visual reference and further analysis. All the scanned images were sorted into folders to present each year.

	L_No	Book Title	Author's Name	Publisher
C9-3	104 J20	පෙම් හර	ඩී.ඩී.ද. ලැහෙරෝල්	අමරසිංහ සහ සමාගම
C9-10	104 J20	කවි මුතු මාරණ	වැලිමඩ ශ්‍රී විරාලංකාර ස්ථවිරයන් වහන්සේ	ඇන්.ජේ.මැන්ඩිස් (වැලිමඩ)
C9-13	104 J20	සෙනෙහෙලතා කාව්‍යය	මරදානේ වෛද්‍යාචාර්ය ජී.කරුණාරත්න/ ජේ.ඇලෝසියස් පෙරේරා (පවි)	
C11-9	104 B4	ශිෂාවංශකීර්තය	ඩී.ජේ.ද ලාහේ	ඔ.එම්.ෂුවාරිස් අප්පුහාමි
C11-10	104 B4	ඉරණම නොනොත් ලෝකයේ බලවන්තයෝ හයදෙනාගේ කතාව	ඩී.එච.සමරසිංහ	ආර්.ඩබ්.ඩී.මාර්ටින් සිංහෙදා
C11-22	104 B4	චන්ද්‍රපාල කුමරුගේ සහ මියුරාවතී කුමරියගේ කතාව කොත්කනාම පයිගේ රහස	ඇල්.ඩී.ඒ රත්නායක	ආර්.ඩබ්.ඩී ඇඩිවින්
C11-29	104 B4	ඉන්ද්‍රකාම සහ ශ්‍රියාවතී	ඇන්.ඔ.අමරසිංහ	ඇන්.ජේ.කුරේ
C50-14	104 K4	ඕවා මිණි වැල	ඩී.ඩී කරුණාරත්න	
C50-3	104 K4	කර්මඔතුණ්කය හෙවත් චතුර්විධකර්ම විභාගය	මැරිකොටුඉුල්ලේ දේවානන්ද ස්ථවිර ශ්‍රීවාමීහාදයන්	මෙත්තාභාවක ඉුදියන්ශේලාගේ ඔණ්ඩප්පුහාමි
C50-7	104 K4	සත්කාව්‍ය තත්කව දර්ශනය	ඇන්.එච.ඇල්.ඇම් ජේනාරත්න	ඩී.ඔ. පොන්නම්පෙරුම්/එච.ඩී.ඔ ජයසේකර
C19-5	104 V10	ශක වර්ෂ 1847 පංචාංග ලීන	ඇම්.ජී.විදානාරත්න	ධර්මරත්න,ජේ.ඩී
C9-7	104 J20	කුඩි කවි මල්දම	කේ.ඇල්.ඉුනිදාස ගුනතිලක	කර්තෘ
C9-35	104 J20	චන්ද්‍රපාල කුමාරයාගේ කථාව හෙවත් සුදුම සත්යාර නහ	ඇස්.ඇම්.ඉුදලිනාමී	ජී.ඩී.ඇල්බට්
C9-37	104 J20	නිමල සුන්දරී කථාව හෙවත් සුදුම මැණික් ගල් කුන	ජී.ඩී ඩෙවිඩ සිල්වා	කේ.ඩී. පෙරේරා සහ පුත්‍රයෝ
C11-42	104 B4	ඉන්ද්‍රකාම සහ ශ්‍රියාවතී	ඇන්.ඔ.අමරසිංහ	ඔ.ඇස් සිල්වා සමාගම
C50-19	104 K4	ශෘංගාර පුෂ්ප	රාමචන්ද්‍ර	ඔ.යූ. පොඩි අප්පුහාමි
C50-23	104 K4	වනඳනා කවි පොත	වැලිගම ශ්‍රී ඔමාභානන්ද ස්ථවිර	කේ.ඒ.නී වර්ණකුලසූරිය
C50-2	104 K4	අබඩ ඔමා චිනිශ්චය	කෝදාගොඩ උපසේනාභිධාන	ඩී.ජේ.අමරතුංග
C50-15	104 K4	ඉුදුඉුල උපත සහ ඉුදුගුණ සාන්තිය හෙවත් මරණන සැනැල්ල		ආර්.ඩබ්.ඩී සල්මන් අප්පුහාමි
C50-16	104 K4	විතුවල්ලි වත හෙවත් මානලන් කතාව	ඇම්.ඇස්.පෙරේරා	ආර්.ඩබ්.ඩී සල්මන් අප්පුහාමි
C50-17	104 K4	ශ්‍රී විකුම රාජසිංහ ඇමති පරම්පරාවේ බෝධි පිහිටුවීම හෙවත් බෝධිසත්ව චරිය		ඇස්.ජානිස්

Image 05, A section of book cover detail table (Source: author)

Image 06, Screen shot of selected folder representing each year *(Source: author)*

4.2 DEVELOPMENT OF STIMULI BASED ON LITERATURE SURVEY

Based on a thorough literature survey, an initial list of print technologies available during the selected era was listed and grouped into two: Manual and processed printing. The manual printing techniques included four types of relief prints, nine types of intaglio printing, and two types of planographic printing. Processed printing included two for relief printing, five for intaglio printing, and two for planographic printing.

The above data on the print technologies and techniques were included into three individual checklists. Each checklist included literature on how to identify these techniques into rows and empty column were added to be filled at the observation process. A sample of the stimuli for relief print technology is found below.

Table 02: Checklist of identical features in relief printing

Printing method	**Identical features**				
Relief printing					
Rim round of the ink is visible					
Ink squash is visible on the corners					
Stamped look of the prints					
Woodcut	In a crosshatching	A single line has a sweep			
		A single line has an excrescence			
		A single line has sudden change of width			
		A single line has sudden change of direction			
	Lines are visible				
	Lines have more arbitrary variations				
Wood Engraving	In a crosshatching	A single line has a sweep			
		A single line has an excrescence			
		A single line has sudden change of width			
		A single line has sudden change of direction			
	Lines are visible				
	Lines have more arbitrary variations				
	Stipple effect (Large or small squares of wood which prints as large or small dots)				
Line blocks	No intermediate tone. Only pure black or nothing				
	Lines are more like drawing				
	Freely drawn lines				
Relief halftone	Ink squeeze out, ink squash is visible				
	Firm edge, squashed ink rim of each dot is visible				
Metal relief	Solid black areas with patterns of white				
	Small decorative stamped look				
	Dotted white patterns				

Thereafter, the data from the checklist was converted into visual stimulus for easy reference. A sample of the stimuli for relief print technology is found below.

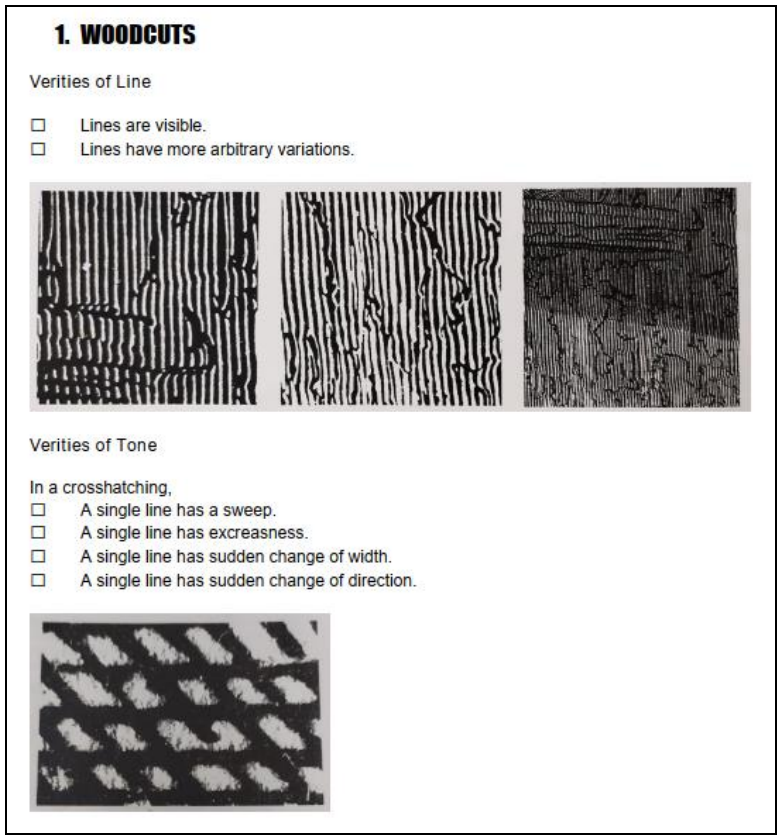

Image 07, Stimuli card for woodcut *(Source: author)*

4.3 OBSERVATION OF THE SCAN AND THE PRIMARY DATA

Observation of the primary data was conducted in two stages. First, we observed the scanned copies of book covers at 600dpi resolution. All the scans were magnified digitally by Adobe Photoshop's zoom tool to avoid the quality reduction of the scanned image. It observed the available images from the year 1870 and then moved into 1871, 1872, and continued through the folders until 1925. Some years had more images, and some had fewer images of the scans. Therefore, images had to be taken into an observation with random sampling according to the availability.

In the second phrase, Original physical book covers were observed through an eyeglass with x4 magnification in the library. It confirmed the observation results of scanned images and updated the checklist data.

4.4 CATEGORIZING DATA CHRONOLOGICALLY

Every book cover was identical to certain printing technology. It can be identified through the marked checklist. A section of a marked checklist is as below.

Printing method	Key Identical points		1872	1873	1876	1877	1883	1884	1887	1887	1888	1888	1889	1889	1890	1890	1890	1897	1900	1901	1901
RELIEF																					
Rim round of the ink is visible			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ink squash is visible on the corners			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Stamped look of the print			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Woodcut	In a cross hatching	A Single line has a sweep					✓	✓		✓	✓		✓								✓
		A single line has a excreasness					✓	✓	✓	✓	✓		✓			✓	✓				✓
		A single line has sudden change of width					✓	✓	✓	✓	✓		✓			✓	✓				
		A single line has sudden change of direction							✓	✓	✓		✓			✓	✓				
	Lines are visible		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Lines have more arbitrary variations.		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						
Wood Engraving	Lines are visible											✓							✓	✓	
	Lines have more arbitrary variations.											✓		✓				✓	✓	✓	
	In a cross hatching	A Single line has a sweep										✓		✓				✓			
		A single line has a excreasness										✓									
		A single line has sudden change of width										✓									
		A single line has sudden change of direction										✓							✓	✓	
	Stipple effect (Larger or small squares of wood which print as large or small dots)											✓		✓				✓	✓	✓	
Line Blocks	No intermediate tones. Only pure black or nothing																				
	Lines are more like in a drawing																				
	Freely drawn lines (Not like in a wood engraving)																				
Relief Halftone	"Ink squeeze out" (Ink squash) is visible																				
	Firm edge and the squashed ink rim of each dot printed																				
Metal relief	Solid black areas with patterns of white.			✓	✓	✓															
	Small decorative stamped look			✓	✓	✓															
	Dotted white patterns visible			✓	✓	✓															

Image 08, A section of a marked checklist *(Source: Author)*

This table is horizontally continued until the year 1925 and vertically continued till planographic printing methods. Since we have completed the checklist chronologically in the observation stage, it has been automatically categorized chronologically to achieve the final analysis stage.

5. Results and Discussion

Tabulating the primary data helped to identify the number of books and to place them chronologically. Then it categorized the data across the timeline. In this study, we have chronologically identified printing technologies in Sri Lanka within 1870 and 1925.

We found relief printing as the dominant printing technique used during this time period. The first decade (1870-80) contained books with metal relief and these book covers contained texts only (mostly the same body typeface was used) and as a decorative element it; boarders were used. The following decade (1880-90) noticed the appearance of woodcut printing and wood engraving printing methods in the covers with the practices of the earlier decade; metal. Thereafter from 1890-1920s, we see developments of wood engraving and woodcut and even a combination of metal and wood. The significant development was that during the early 1890s prints were limited to small illustrations in the middle of the book, and by the late 1890s illustrations occupy majority of the cover. Meanwhile, by 1900's refined wood engravings and woodcut prints are evident proving the improvement of skill while the continuation of text-based cover designs continues throughout this timeline.

6. Conclusion

This study observed primary data in this case original printed books cover designs in Sri Lanka between the early newspaper era. This era also demonstrates the rising of the local book publishing industry where numerous publishers and authors had come together. By observing these early cover designs we were able to document historical data that contributes to historical research and, it is with such research we are able to identify and differentiate a problem or a field of study that sometimes

help generate hypothesis. Testing such hypothesizes lead to new understanding of the past and highlights the need and its relevance in shaping our present and future.

Thus, to achieved this, the research discussed early printing techniques used around the world and how the physical prints can be identified and categorized. The comparison of this knowledge and the primary data led us towards building a hypothesis such as *what were the trending technologies of this era*?. To test such hypotheses this research documents how and when the technology was used as contribution towards establishing new knowledge within the practice of historical research.

7. Acknowledgments

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Poster Abstracts

A RELATIONSHIP BETWEEN INDOOR AIR QUALITY AND ENERGY CONSUMPTION BASED ON OCCUPANCY BEHAVIOUR IN SRI LANKAN INDUS-TRIAL BUILDINGS

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Abstrat
This research aims to provide a guideline for researchers, architects and designers with information on how to optimize good indoor air quality and energy usage within structure based on oc-cupancy behaviour. Primarily, literature review was done and then, a preliminary survey was conducted with three industry experts to gain applicability of this research to the Sri Lankan indus-trial building. The questionnaire survey was conducted by distributing questionnaires among 40 industry experts who have experience in industrial building operation and 30 of them respond-ed back. Microsoft excel data analysis package, relative important index and bivariate analysis were used to analyse the collected data. Cronbach alpha test was used to identify the reliability of the collected data set. The guideline for building operator and designers to balance between IAQ and energy consumption based on occupancy behaviour can improve the building efficiency was set.

PROMPTING PUBLIC AWARENESS ABOUT MARINE LIFE OF BANGLADESH

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Abstract
After the new demarcation of the area of the Bay of Bengal, Bangladesh now possesses enormous marine resources which is vital for the livelihood of her coastal communities and the national economy. But due to inadequate technological advancement and financial support, the country lacks in the sustainable protection or utilization of its marine resources. This paper attempts to create public awareness through an interactive exploration of marine life while promoting sustainable marine tourism and investigates how the surveys and interviews have helped to establish an understanding of people's perceptions concerning marine biodiversity and its current state. For the proposed study, Cox's Bazar is selected as a potential site for marine tourism as well as to demonstrate development strategy in the waterfront, since it is one of the prime tourist locations of Bangladesh and a number of Waterfront developments are suggested for interactive exploration of marine life. It will give the public an insight regarding how human habits, pollution and waste materials thrown into the sea affect the marine creatures. This paper will also suggest how human beings can live in harmony with nature by adopting to sustainable ways.

HEALING BALU RIVER, DHAKA: RESTORATION THROUGH REVITALIZING THE RIPARIAN BUFFER ZONE

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Abstract
The growth of Dhaka, the capital of Bangladesh, is characterized by rapid urbanization and frequent expansion, due to which its urban tissues are transforming in an environmentally detrimental manner. As a result, a 110 km long waterway network of four significant rivers of Dhaka, which was once an integrated part of the city fabric, continues to disappear. Flowing for 44km along its east side, Balu River is an important lifeline for Dhaka. Due to massive water pollution and rapid encroachment, Balu is now in its deathbed having no trace of flood basin areas thereby causing brutal ecological change to a precious landscape. This research explores the present declining condition of the river and its surrounding edge and seeks to illustrate how a polluted dying river can be revitalized. Among various methods, riparian ecosystem restoration is one that seeks to correct water quality, degraded ecosystems, and recreate lost habitats. A qualitative research method is used to address the research problems that involve the collection of the primary data through visual observations, photographs, field surveys, sketches, and field notes. Later computer-aided drawings based on map and field surveys have been prepared. The study is focused on finding a suitable landscape solution to restore the river edge and also a possible buffering system to protect from future encroachment, as well as their integration with present and future urban development. In overview, this study aims to come up with a model that will combine a new city pattern with the rejuvenation of a river system, thus opening the doors to a new urban experience.

ABSTRACTION OF NATURAL AND MYTHICAL DESIGN ELEMENTS IN THE 18TH CENTURY TEMPLE PAINTINGS OF SRI LANKA

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Abstract
Sri Lanka possess over 200 Buddhist temples with mural painting, scattered throughout the island. These paintings were done as a form of veneration, and as a mode of teaching the devotee of Buddha's previous lives. This research evaluates two elements, "God Sakka"- "Vessantara Jataka", Madavala temple and "Horse", - "Vessanthara Jataka", Degaldoruwa cave temple. The 18th century temple paintings were a creation of artistic communities for the communication of general laymen, this research is a brief attempt to understand how visual communication was handled by artists to communicate it to different communities. Reason for selecting just two natural and mythical elements found on painting is to better understand about the method of constructing the abstract forms in depth and also to know about the artist's knowledge on human perception. For data collection method, literature review, direct observation, a questionnaire with 15- 60 age group and Interviews with over 60 years elders were done. The selected elements were directly observed and methods of their formation were confirmed through a literary survey. With the combination of data, an attempt is finally made to analyze the communicative methods used for human visual perception by the ancient artist through the design principles and elements used.

18TH CENTURY TEMPLE PAINTINGS OF SRI LANKA; THE THEORY BEHIND THE ABSTRACTION OF DESIGN ELEMENTS

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Abstract
Mural paintings of Sri Lanka, the most significant visual communicative methods used by the ancient artists which is one of the premium resources of historical evidences in the country. There are many available interpretations on these mural paintings but very few attempts have been made to reveal their abstractive approach which is central to its communicative transfer process. The key objective of this research is to concentrate on two elements from 18th century mural paintings to evaluate the approaches of visual abstraction of natural and mythical subjects through communication perspective. Both qualitative and quantitative approaches were considered in the data collection methods. A questionnaire survey covering people of different backgrounds was taken up primarily to understand how and to what level they understood the communicative process developed by the community of ancient artists. Perceptions on recognition, distractions, emotions, memories, and comparative beliefs of the participants were taken into consideration. The findings highlighted the use of repetitive details, colours and contextual objects of elements that contributed to the construction of this unique communicative achievements.

AN APPROACH OF AMALGAMATION TOWARDS UPHOLDING THE ETHNIC TRADITION OF A SANTALI VILLAGE

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The human mind seeks a sense of belongingness in the dwelling place. But the people of Noroshinghor-gram, under a clustered village housing scheme, are living in shiny boxes with the scorching sun above, a typical weathering condition of the northern part of Bangladesh. There prevails a conflict between ethnic vernacular housing practice and the stereotype of rural housing that replicates the layout without geographic and contextual considerations. The conservation of ethnicity failed due to the exclusion of socio-cultural aspects related to the Santali tradition and belief system. The design approaches are based on the comparison of the data, collected from the site and the tracebacks of the Santali past. The masterplan is divided into four scales: adobe, cluster, community, and territory, which is to be built with the local materials: Mud, Bamboo, Brick in the foundation and linseed oil, rope-buttress to strengthen the mud plaster. A local belief, wide windows allow a negative omen so, mud panel with patterns, derived from the alpana for spiritual worship, is used instead. There is design flexibility for the further extension with lightweight enclosures. This design proposal adds minimum interventions to avoid juxtaposition of elements and keep the prominent ethnic features dominant.

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