The Second World Construction Symposium

SB 13

SOCIO-ECONOMIC SUSTAINABILITY IN CONSTRUCTION: PRACTICE, POLICY AND RESEARCH

14 - 15 June 2013
Colombo, Sri Lanka

Programme and Abstracts

Ceylon Institute of Builders (CIOB)
International Council for Research & Innovation in Building and Construction (CIB - W107)
Building Economics & Management Research Unit (BEMRU), Department of Building Economics, University of Moratuwa
International Initiative for a Sustainable Built Environment (iiSBE)
United Nations Environment Programme – Sustainable Buildings and Climate Initiative UNEP-SBCI
International Federation of Consulting Engineers (FIDIC)

THE SECOND
WORLD CONSTRUCTION SYMPOSIUM
2013

SOCIO-ECONOMIC SUSTAINABILITY IN CONSTRUCTION: PRACTICE, POLICY AND RESEARCH

14 - 15 June 2013

at
Cinnamon Lakeside Hotel
Colombo, Sri Lanka

Organised by

Ceylon Institute of Builders (CIOB),
International Council for Research and Innovation in Building and Construction (CIB – SB13)
International Initiative for a Sustainable Built Environment (iiSBE)
United Nations Environment Programme-Sustainable Buildings and Climate Initiative (UNEP-SBCI)
International Federation of Consulting Engineers (FIDIC)
and
Building Economics and Management Research Unit (BEMRU),
Department of Building Economics, University of Moratuwa, Sri Lanka

ISBN: 978-955-4516-04-5

Published by:
Ceylon Institute of Builders (CIOB),
No. 48, CSCT Building,
Thalawathugoda Road,
Pitakotte,
Sri Lanka.
Tel : 0094-11-3140355
Fax : 0094-11-2885933
Email : info@ciob.lk; ciob2013@yahoo.com
Web : www.wcs2013.com

CONTENTS

Messages..... 03

Keynote Speaker..... 11

Organising Committee..... 15

Scientific Committee..... 16

Symposium Information..... 17

Symposium Programme..... 18

Symposium Session Plan At-A-Glance..... 21

Detailed Session Plan 22

Paper Abstracts..... 39

Acknowledgements..... 93

Sponsors, Partners and Advertisers..... 95

MESSAGES

Hon. Minister Wimal Weerawansa

Minister of Construction, Engineering Services, Housing and Common Amenities

It is with great pleasure that I send this message and extend my warm welcome to all delegates from Sri Lanka and overseas who participate in the 2nd World Construction Symposium and International Construction EXPO 2013 at the Cinnamon Lakeside Hotel and BMICH respectively during the period of 14 to 16 June 2013 which is jointly organised by the Ceylon Institute of Builders in collaboration with International Council for Research and Innovation in Building and Construction (CIB) in the Netherlands and the Department of Building Economics of the University of Moratuwa.

I consider this Symposium very timely and relevant to Sri Lanka in the context of its current economic development effort, particularly in the infrastructure and urban development areas. Sri Lanka is now emerging as a strong nation with rapid economic development. The construction industry is the barometer of a nation's economic development. Sri Lanka's Construction Industry too is booming and expanding into new areas of innovation resulting in economic benefits to larger segments of the population.

The 2nd World Construction Symposium 2013 will be an ideal platform to exchange views and experiences on various issues related to construction industry. It is my fervent hope that the Symposium will benefit all those participating in achieving their professional and academic expectations whilst giving opportunities to all stakeholders to build new contacts and alliance benefiting the construction industry in Sri Lanka.

I wish the 2nd World Construction Symposium 2013 all success.

Prof. Chitra Weddikkara
Chairperson
World Construction Symposium 2013

It is with appreciation that I take up the invitation to give a message as the Chairperson of the Second World Construction Symposium 2013 and it is with great pleasure that I welcome all participants to the event. This year's theme is "Socio – Economic Sustainability in Construction: Practice, Policy and Research".

As an event where academics and industry participants in construction gather to exchange views and findings, I believe this symposium is timely, discussing relevant and important topics. The theme of 'Socio –Economic Sustainability in Construction: Practice, Policy and Research" has been chosen as Sri Lanka, has now come out of a civil war, is poised to further develop its built environment its infrastructure and its socio- economic framework. In having understood the need to position ourselves, it is important to now discuss issues such as sustainability in construction practice, its implementation and the policy framework for the future development of our country. We questioned ourselves 'How should we meet these challenges?' I am sure that all participants from around the world will look forward to identify challenges and understanding how to face the issues pertaining to sustainability; unravelling the answers and their knowledge on various issue so that the Sri-Lankan counterparts will be enriched in the knowledge rather than them reinventing the wheel.

In acting as a platform for knowledge sharing, it also offers Sri Lankan professionals and academics to meet specialists from overseas. In conducting the event, I believe CIOB, the professional body for Builders in Sri Lanka, who work to inspire, educate and train builders as professionals in Sri Lanka, will receive international exposure which they richly deserve. The event is also strengthened by the research excellence of its organizing partner; the Building Economics and Management Research Unit (BEMRU) of the Department of Building Economics of the University of Moratuwa; who too will stand to gain much in the academic field.

I hope all invitees would take this opportunity to meet and learn from colleagues in the global construction industry, making it a stimulating and educative symposium.

Dr. Rohan Karunaratne
President
The Ceylon Institute of Builders (CIOB)

The Ceylon Institute of Builders (CIOB) is pleased to organise the 'Socio Economic Sustainability in Construction' The Second World Construction Symposium 2013, together with the CIB Netherlands and the University of Moratuwa, Sri Lanka. The CIOB with its roots in the year 1961 has a solid history of acting as the professional body in the building and construction industry in the island. Hence, we are honoured to be part of this symposium that would help industry stakeholders develop an understanding of challenges faced by the global industry, while having an opportunity to expand their international network.

Invitations for the symposium have been extended to professional and academic participants from over 30 countries, thereby bringing in various inputs from across the globe. Companies developing technologies to circumvent or meet these issues are expected to provide new insights. And leading academics and students have been invited to enlighten the audience on recent scientific findings. Therefore, I strongly believe that our invitees would find the symposium to be of great significance.

I would also like to take this opportunity to mention 'Construction Expo 2013', which will be held in parallel to the Symposium at the BMICH, Colombo. It would be the, largest international construction event to be held in Sri Lanka. I invite companies which are interested in adopting new technologies and innovations to come and visit Construction Expo 2013.

I take this opportunity to thank the ministries and professional institutions who have helped us in organising the Second World Construction Symposium 2013. I am much grateful to CIB Netherlands and the BEMRU, Department of Building Economics, University of Moratuwa who have been an integral part of the organising team.

Eng. Saliya Kaluarachchi
Hon. Secretary
The Ceylon Institute of Builders (CIOB)

It is indeed a privilege to be part of the organising committee of an international symposium that would stand as a milestone for most of its participant countries, including host country Sri Lanka. The symposium will bring together professionals and academics from around the world to discuss and present papers on issues that we all in the global construction industry have come to find as challenges.

I should first extend my sincerest appreciation to the International Council for Research and Innovation in Building and Construction (CIB), the global body that stands for the development of the industry, for their solid guidance in organising this event. I also thank all other partner organizations which have come forward to make this year's Symposium a success.

I would like to express my gratitude to the Building Economics and Management Research Unit (BEMRU), the research arm of the Department of Building Economics at the University of Moratuwa, Sri Lanka for their unwavering support. Their valued academic input will strengthen the local input of symposium, and I hope that its participants too will gain from the knowledge transfer.

I would also like to thank Ministry of Construction and Engineering Services, Housing and Common Amenities, Ministry of Economic Development, Ministry of External Affairs, Ministry of Labour and Labour Relations, Ministry of Land and Land Development, Senior Ministry of National Resources with other national bodies such as Institute of Engineers of Sri Lanka, Chamber of Construction Industries Sri Lanka, Federation of Chambers of Commerce and Industries of Sri Lanka, Organisation of Professional Association, Institute of Quantity Surveyors Sri Lanka and other construction related Professional bodies, the management of BMICH, the management of Cinnamon Lakeside Hotel for the assistance provided.

Mr. Kalana de Alwis
Mr. Sagara Gunawardena
Co-Chairmen
World Construction Symposium 2013

It is with great pleasure and enthusiasm we write this message and extend our warm welcome to all delegates from Sri Lanka and overseas who participate in the SB 13 – Second World Construction Symposium and International Construction Expo 2013 at the Cinnamon Lakeside Hotel and BMICH respectively during the period of 14 to 16 June 2013 which is jointly organized by the Ceylon Institute of Builders in collaboration with International Council for Research and Innovation in Building and Construction (CIB) in the Netherlands and the Department of Building Economics of the University of Moratuwa.

Sri Lanka after the emergence from the period of brutal terrorism of three decades was able to achieve many economic milestones surpassing many other countries in the region. Today, our nation is breathing with peace and harmony and with the development of the country. Sri Lanka National economy has started to boom and rapid development is taking place all over the country. The construction industry has shown a considerable improvement in all sectors concerned.

The Second World Construction Symposium 2013 will be an International platform to exchange views and experiences on various issues related to construction industry for both local and International delegates, who will carry back memories of creating new skills, technology and learning for the development of the construction industry.

Mr. Indunil Seneviratne
Head of the Department
Department of Building Economics
University of Moratuwa

I warmly welcome all delegates to the Second World Construction Symposium and International Construction Expo 2013 at the Cinnamon Lakeside Hotel and BMICH respectively during the period of 14th June to 16th June 2013. This is an exciting venture jointly organized by Ceylon Institute of Builders (CIOB), the International Council for Research and Innovation in Building and Construction (CIB – SB13), International Initiative for a Sustainable Built Environment (iiSBE), United Nations Environment Programme - Sustainable Buildings and Climate Initiative (UNEP-SBCI), International Federation of Consulting Engineers (FIDIC) and The Building Economics and Management Research Unit (BEMRU), Department of Building Economics, University of Moratuwa, Sri Lanka.

Sri Lanka, after the emerging from the period of brutal terrorism for over three decades was able to achieve many economic milestones surpassing many other countries in the region. Today, our nation is breathing with peace, harmony and marching forward with a fast tracked sustainable development program focusing on infrastructure development implemented under the "Mahinda Chinthana", the Vision for Future New Sri Lanka. The Sri Lankan National economy has started to boom with this rapid development taking place all over the country. The construction industry has shown considerable growth in all sectors concerned.

The Second World Construction Symposium 2013 will be a platform for both Local and International delegates to share and exchange practice, policy and research initiatives on various issues related to socio-economic sustainability of the construction industry. This would further enable to carry back experiences of sharing new skills, technologies and lessons learnt from the current development projects in Sri Lanka.

KEYNOTE SPEAKER

Prof. Tay Kheng Soon
Professor at National University of Singapore

Prof. Tay Kheng Soon is a practising Architect and Adjunct Professor at the National University of Singapore's School of Architecture. He was the President of the Singapore Institute of Architects and founding member and Chairman of SPUR (Singapore Planning and Urban Research).

Prof. Tay Kheng Soon was the Chairman of the Task Force for the long-term development of the National Museum of Singapore, founding Chairman of the Substation, a cutting-edge arts centre, and headed the committee on heritage for the Singapore Advisory Council on Culture and the Arts. Prof. Tay Kheng Soon civic activities include being a member of the advisory panel of the Government Parliamentary Committee on national development, and a member of the advisory panel of the Singapore Institute of Policy Studies. In 1997, he was appointed as an Adjunct Professor of Architecture at RMIT Australia, and in 1998 made Adjunct Associate Professor at the National University of Singapore. Prof. Tay's academic involvements include being a visiting scholar under the Aga Khan Program at MIT in 1986 and again in 1989. He was also a research fellow with the Institute of Southeast Asian Studies. To this day, Prof. Tay Kheng Soon continues to churn out creative, out-of-the-box ideas that he personally sees through to reality via his architectural practice Akitek Tenggara in Singapore, which he founded in 1976.

ORGANISING COMMITTEE

Chairperson	Prof. Chitra Weddikkara
Co-Chairs	Mr. Sagara Gunawardena Mr. Kalana Alwis
Advisors	Dr. Rohan Karunaratne Eng. Saliya Kaluarachchi Mr. Indunil Seneviratne
Organising Committee	Mr. Ruwan de Silva Eng. Jayakish Thudawe Eng. Mega Kularathna Mr. Rangi Hewage Eng. Ashoka Randeni Mr. Mahanama Jayamanne Mr. Sudath Amarasinghe Dr. Tissa Meepe Eng. Walter Perera Mr. I. D. Wijeratne
Scientific Committee Chairs	Dr. Yasangika Sandanayake Dr. Nirodha Fernando
Symposium Secretariat	Ms. Chandani Hadiwattege Ms. Chethana Illankoon Ms. Florencia Victoria Ms. Tharusha Ranadewa Mr. Cyril de Silva Mr. Rohana Balasuriya
Event Director	Mr. Samantha Abeywickrama

SCIENCITIFIC COMMITTEE

Chairs

Dr. Yasangika Sandanayake	*University of Moratuwa, Sri Lanka*
Dr. Nirodha Fernando	*University of Moratuwa, Sri Lanka*

Members

Dr. Vasantha Abeysekara	*University of South Queensland, Australia*
Prof. Dilanthi Amaratunga	*University of Salford, United Kingdom*
Assoc. Professor Umberto Berardi	*Worcester Polytechnic Institute, USA*
Prof. Peter Brandon	*University of Salford, United Kingdom*
Prof. Steve Burroughs	*University of Canberra, Australia*
Dr. Harsha Cabral	*President's Counsel, Sri Lanka*
Prof. Edwin H. W. Chan	*Hong Kong Polytechnic University, Hong Kong*
Dr. Arun Chandramohan	*National Institute of Technology Calicut, India*
Dr. K.A.K. Devapriya	*University of Moratuwa, Sri Lanka*
Prof. Rohinton Emmanuel	*University of Glasgow, Scotland*
Dr. Hwang Bon-Gang	*National University of Singapore, Singapore*
Prof. Jacqueline Glass	*Loughborough University, United Kingdom*
Assoc. Prof. Vanessa Gomes	*University of Campinas, Brazil*
Prof. Richard Haigh	*University of Salford, United Kingdom*
Mr. Suranga Jayasena	*University of Moratuwa, Sri Lanka*
Prof. Mike Kagioglou	*University of Salford, United Kingdom*
Dr. Gayani Karunasena	*University of Moratuwa, Sri Lanka*
Prof. Mohan Kumaraswamy	*University of Hong Kong, Hong Kong*
Dr. Jamie Mackee	*University of Newcastle, Australia*
Assist. Prof. Mahta Mirmoghtadaee	*Technical University – Berlin, Iran*
Prof. Florence Y.Y. Ling	*National University of Singapore, Singapore*
Prof. George Ofori	*National University of Singapore, Singapore*
Mrs. Kanchana Perera	*University of Moratuwa, Sri Lanka*
Prof. Srinath Perera	*University of Northumbria, United Kingdom*
Dr. Upendra Rajapakshe	*University of Moratuwa, Sri Lanka*
Dr. Sepani Senaratne	*University of Western Sydney, Australia*
Mr. Indunil Seneviratne	*University of Moratuwa, Sri Lanka*
Prof. Alfredo Serpell	*Catholic University of Chile, Chile*
Assoc. Prof. Begum Sertyesilisik	*Istanbul Technical University, Turkey*
Dr. Nayanathara de Silva	*University of Moratuwa, Sri Lanka*
Assoc. Prof. Lalith de Silva	*University of Moratuwa, Sri Lanka*
Dr. Gamini Weerasinghe	*University of Moratuwa, Sri Lanka*
Dr. Janaka Wijesundara	*University of Moratuwa, Sri Lanka*

SYMPOSIUM INFORMATION

International Construction EXPO

The International Construction EXPO inauguration is on 14 June 2013 from 09.30 am to 12.00 noon at the Bandaranaike Memorial International Conference Hall (BMICH), Bauddhaloka Mw, Colombo 07.

The Second World Construction Symposium

The Symposium is on 14 June 2013 from 01.30 pm to 07.30 pm and on 15 June 2013 from 09.00 am to 03.30 pm at the Cinnamon Lakeside Hotel, 115, Sir Chittampalam A. Gardiner Mawatha, Colombo 02.

Symposium Secretariat

Ceylon Institute of Builders (CIOB), No. 48, CSCT Building, Thalawathugoda Road, Pitakotte,
Sri Lanka
Tel : 0094-11-3140355 (Samantha) or +94771227269 (Chandanie)
Fax : 0094-11-2885933
Email : ciob2013@yahoo.com
Website : http://www.wcs2013.com

Language

The official language of the symposium is English. There will be no simultaneous translation.

Dress Code

Symposium - Business, Lounge or National
Dinner - Smart Casual

Registration

Symposium delegates can collect their materials at the registration desk, located at the Cinnamon Lakeside Hotel. Opening times of the registration desk will be from 12.00 noon to 06.00 pm on 14 June 2013 and from 8.30 am to 3.30 pm on 15 June 2013.

Secretariat Room

During the symposium, the secretariat room is located at the Empress Suite of the Cinnamon Lakeside Hotel, where the main symposium is being held. The opening hours of the secretariat will be from 08.30 am to 07:00 pm on 14 – 15 June 2013.

Certificate of Attendance

A certificate of attendance will be issued to all participants, after the symposium sum-up.

Awards

Best Paper Award and Best Presentation Award will be awarded during the symposium cultural dinner.

Liability

The organising committee is not liable for personal accidents, loss or damage to private properties of registered participants during the Symposium. Participants should make their own arrangements with respect to personal insurance.

Disclaimer

Whilst every attempt be made to ensure that all aspects of the Symposium mentioned in this announcement will take place as scheduled, the Organising Committee reserves the prerogative to make last minute changes should the need arise without prior notice.

SYMPOSIUM PROGRAMME

Friday, 14 June 2013

International Construction EXPO 2013

09.30 am	**Opening Ceremony**	BMICH
12.00 pm	Lunch	Waterside (Cinnamon Lakeside)

The Second World Construction Symposium 2013

12.30 pm	**Symposium Registration**	Kings Court (Cinnamon Lakeside)
01.30 pm	**Symposium Inauguration**	
01.40 pm	Welcome Address by Symposium Chairperson **Prof. Chitra Weddikkara**	
01.50 pm	Address by Vice Chancellor, University of Moratuwa **Prof. Ananda Jayawardena**	
02.00 pm	Address by CIB – SB13 Coordinator **Mr. Emilio Miguel Mitre**	
02.10 pm	Address by Chief Guest **Hon. Wimal Weerawansa, *Minister of Construction, Engineering Services, Housing and Common Amenities***	
02.25 pm	Keynote Address on **"Rubanisation" Prof. Tay Kheng Soon**	
03.10 pm	Presentation by **Seirra Cables Plc.** (***Gold Sponsor***)	
03.25 pm	Vote of Thanks by Hon. Secretary, CIOB **Mr. Saliya Kaluarachchi**	
03.30 pm	End of Symposium Inauguration	
03.30 pm	Tea / Coffee Break	

04.00 pm	**Parallel Sessions** *(There will be THREE parallel sessions)*	Dukes Court 1 & 2 and Queens Court
05.30 pm	Tea / Coffee Break	
06.00 pm	**Parallel Sessions** *(There will be TWO parallel sessions)*	Dukes Court 1 & 2
07.30 pm	End of Programme	

Saturday, 15 June 2013

09.00 pm	**Parallel Sessions** *(There will be THREE parallel sessions)*	Dukes Court 1 & 2 and Queens Court
10.30 am	Tea / Coffee Break	
11.00 am	**Parallel Sessions** *(There will be THREE parallel sessions)*	Dukes Court 1 & 2 and Queens Court
01.00 pm	Lunch	Waterside
02.00 pm	**Symposium Sum-Up**	Kings Court
02.00 pm	Panel Discussion on **"Socio-Economic Sustainability in Construction"** **Prof. Chitra Weddikkara** (Symposium Chairperson) **Prof. Tay Kheng Soon** (National University of Singapore, Singapore) **Prof. Rohinton Emmanuel** (Glasgow Caledonian University, UK) **Prof. Ranjith Dissanayake** (University of Peradeniya, Sri Lanka) **Prof. Lalith de Silva** (University of Moratuwa, Sri Lanka)	
02.45 pm	Presentation by **Siemens Ltd.** (***Silver Sponsor***)	
03.00 pm	Rapporteur's Report **Dr. Kapila Devapriya** **Dr. Gayani Karunasena**	
03.15 pm	Vote of Thanks by Scientific Committee Co-Chairperson **Dr. Yasangika Sandanayake**	
03.30 pm	End of Programme	

Symposium Dinner

07.00 pm	**Cultural Dinner**	Waterside, Cinnamon Lakeside Hotel

SYMPOSIUM SESSION PLAN AT-A-GLANCE

Friday, 14 June 2013

09.00 - 09.15						
09.15- 09.30						
09.30 - 09.45	International Construction EXPO 2013 Opening Ceremony					
09.45 - 10.00						
10.00 - 10.30						
10.30 -11.00						
11.00 - 11.15						
11.15 - 11.30						
11.30 - 11.45						
11.45 - 12.00						
12.00 - 12.15	Lunch					
12.15 - 12.30						
12.30 - 13.00						
13.00 - 13.30	Registration					
13.30 - 14.00	The Second World Construction Symposium 2013 Inauguration Ceremony					
14.00 - 15.30						
15.30 - 16.00	Tea / Coffee Break					
16.00 - 16.15	**Session 1A**	S6026	**Session 1B**	S6066	**Session 1C**	S6001
16.15 - 16.30		S6058		S6054		S6068
16.30 - 16.45		S6021		S6076		S6055
16.45 - 17.00		S6073		S6025		S6060
17.00 - 17.30	Q&A		Q&A		Q&A	
17.30 - 18.00	Tea / Coffee Break					
18.00 - 18.15	**Session 2A**	S6053	**Session 2B**	S6059		
18.15 - 18.30		S6031		S6042		
18.30 - 18.45		S6041		S6045		
18.45 - 19.00		S6050		S6077		
19.00 - 19.15	Q&A			S6072		
19.15 - 19.30			Q&A			
19.30 - 22.00						

Saturday, 15 June 2013

	Session 3A	S6002	**Session 3B**	S6018	**Session 3C**	S6013
		S6048		S6039		S6069
		S6049		S6046		S6016
		S6040		S6061		S6032
	Q&A		Q&A		Q&A	
	Tea / Coffee Break					
	Session 4A	S6012	**Session 4B**	S6003	**Session 4C**	S6015
		S6007		S6051		S6014
		S6036		S6070		S6075
		S6037		S6004		S6022
		S6044		S6006		S6067
		S6065		S6009		S6027
	Q&A		Q&A		Q&A	
	Lunch					
	Symposium Sum-Up					
	Cultural Dinner					

DETAILED SESSION PLAN

Friday, 14 June 2013

Session 1A

Theme	:	**Professional Ethics and Law in Construction**
Session Chair	:	Dr. Harsha Cabral
Coordinator	:	Dr. Nayanthara De Silva
Venue/Time	:	Dukes Court 1 – 4.00 pm – 5.30 pm

Time	Paper ID, Title and Author(s)
4.00 – 4.15 pm	**S6026 - Frequently Challenged Determinations of the Engineer in Sri Lankan Construction Contracts** *Himal Suranga Jayasena, Gihan Geethanath Seram and Jery Johnson*
4.15 – 4.30 pm	**S6058- Stakeholders' Preference Towards the Use of Conflict Management Styles in Dual Concern Theory in Post Contract Stage** *M. A. C. L. Gunarathna and Nirodha Gayani Fernando*
4.30 – 4.45 pm	**S6021 - Special Features, Experiences and New Trends in Arbitration in the Construction Industry of Sri Lanka** *Mahesh Abeynayake and Chitra Weddikkara*
4.45 – 5.00 pm	**S6073 - Coping with Ethical Dilemmas in a Socially Responsible Manner – Quantity Surveyors' Perspective** *Dineth Kalukapuge and L. D. Indunil P. Seneviratne*
5.00 – 5.30 pm	**Q&A**

Friday, 14 June 2013

Session 1B

Theme	:	**Sustainable Facilities Management**
Session Chair	:	Prof. P. K. S. Mahanama
Coordinator	:	Dr. Gayani Karunasena
Venue/Time	:	Dukes Court 2 – 4.00 pm – 5.30 pm

Time	Paper ID, Title and Author(s)
4.00 – 4.15 pm	**S6066 - Influence of Change Management for Effective Outsourcing of Facilities Management Services** *Pournima Sridarran and Nirodha Gayani Fernando*
4.15 – 4.30 pm	**S6054 - In-House versus Outsourcing Facilities Management: A Framework for Value-Added Selection in Sri Lankan Commercial Buildings** *M. H. S. Ahamed, B. A. K. S. Perera and I. M. C. S. Illankoon*
4.30 – 4.45 pm	**S6076 - Integrated Facilities Management Practices in Sri Lanka: A Preliminary Investigation** *R. P. N. P. Weerasinghe and Y. G. Sandanayake*
4.45 – 5.00 pm	**S6025 - Contribution of Building Management System towards Sustainable Built Environment** *W. H. C. D. Kumara and K. G. A. S. Waidyasekara*
5.00 – 5.30 pm	**Q&A**

Friday, 14 June 2013

Session 1C

Theme	:	**Sustainable Procurement Strategies**
Session Chair	:	Prof. Lalith De Silva
Coordinator	:	Mrs. Anuradha Waidyasekara
Venue/Time	:	Queens Court – 4.00 pm – 5.30 pm

Time	Paper ID, Title and Author(s)
4.00 – 4.15 pm	**S6001 - Search for Key Performance Indicators (KPIs) for Target Cost Contracts in Hong Kong** *Daniel W. M. Chan and Joseph H. L. Chan*
4.15 – 4.30 pm	**S6068 - Impact of Government Policies and Regulations when Adopting Alternative Procurement Methods** *Chamal Wijewardana, Himal Suranga Jayasena and K.A.T.O. Ranadewa*
430 – 4.45 pm	**6055 - Relationally Integrated Value Networks for Sustainable Procurement** *Sachithra Weerapperuma, Nayanathara De Silva, Mohan Kumaraswamy and Malik Ranasinghe*
4.45 – 5.00 pm	**S6060 - E-Tendering Framework for Public Procurement in Sri Lanka** *Piyadasun Amarapathy, Himal Suranga Jayasena and K. A. T. O. Ranadewa*
5.00 – 5.30 pm	**Q&A**

Friday, 14 June 2013

Session 2A

Theme	:	**Construction Research**
Session Chair	:	Prof. Lalith De Silva
Coordinator	:	Mr. Vijitha Dissaratne
Venue/Time	:	Dukes Court 1 – 6.00 pm – 7.30 pm

Time	Paper ID, Title and Author(s)
6.00 – 6.15 pm	**S6053 - Role of Academic Research in Sustainable Construction Practice** *Chandanie Hadiwattege, Nirodha Fernando and Sepani Senaratne*
6.15 – 6.30 pm	**S6031 - Approach to Sustainable Development through Architectural Education: Insight to the Perceptions of Sri Lankan Students** *Marini Samaratunga*
6.30 – 6.45 pm	**S6041 - Development Supportive Novel Trends and Practices for Construction Sector** *Jayanga Denagama and Chandanie Hadiwattege*
6.45 – 7.00 pm	**S6050 - Psychological Contract with Construction Labour for Sustainability in Construction** *L. L. Ekanayake and S. A. V. N. Chandradasa*
7.00 – 7.30 pm	**Q&A**

Friday, 14 June 2013

Session 2B

Theme	:	**Project Management in Construction**
Session Chair	:	Dr. Daniel W. M. Chan
Coordinator	:	Mr. Suranga Jayasena
Venue/Time	:	Dukes Court 2 – 18.00 pm – 19.30 pm

Time	Paper ID, Title and Author(s)
6.00 – 6.15 pm	**S6059 - Viability of Private Sector Involvement in Infrastructure Project Development in Developing Country** *Samanthi Manoja Tanabe and Malik Ranasinghe*
6.15 – 6.30 pm	**S6042 - Plant and Equipment Management to Minimize Delays in Road Construction Projects** *Sri Nuwan Randunupura and Chandanie Hadiwattege*
6.30 – 6.45 pm	**S6045 - Utility Factors Affecting for Selecting Delay Analysis Technique** *H. M. C. K. Sudeha, B. A. K. S. Perera and I. M. C. S. Illankoon*
6.45 – 7.00 pm	**S6077 - Overcoming Sustainability Issues through Financial Risk Management in Private Finance Initiative Projects** *U. T. Withanachchi and Nirodha Gayani Fernando*
7.00 – 7.15 pm	**S6072 - Common Errors that are being made in Preparing and Pricing BOQ in Sri Lankan Construction Industry** *A. A. Uthpala Shammi Gunathilaka and L. D. Indunil P. Senevirathne*
7.15 – 7.30 pm	**Q&A**

Saturday, 15 June 2013

Session 3A

Theme	:	**Health and Safety in Built Environments**
Session Chair	:	Dr. Gamini Weerasinghe
Coordinator	:	Ms. Damitha Rajini
Venue/Time	:	Dukes Court 1 – 9.00 am – 10.30 am

Time	Paper ID, Title and Author(s)
9.00 – 9.15 am	**S6002 - Application of the Safe Working Cycle (SWC) in Hong Kong Construction Industry: Literature Review and Future Research Agenda** *Daniel W. M. Chan and Henry T. W. Hung*
9.15 – 9.30 am	**S6048 - Effective Fire Safety Planning for Industrial Buildings: A Literature Review** *A. M. S. U. Athapaththu, Nirodha Gayani Fernando and D. M. P. P. Dissanayake*
9.30 – 9.45 am	**S6049 - Strengthening the Safety Culture for Organizational Sustainability** *N. H. C. Manjula and Nayanthara De Silva*
9.45 – 10.00 am	**S6040 - Factors Affecting Environmental Health and Safety in Healthcare Sector** *Brinda Saranga and Damitha Rajini*
10.00 – 10.30 am	**Q&A**

Saturday, 15 June 2013

Session 3B

Theme	:	**Energy Management**
Session Chair	:	Dr. Upendra Rajapaksha
Coordinator	:	Ms. Chandanie Hadiwattege
Venue/Time	:	Dukes Court 2 – 9.00 am – 10.30 am

Time	Paper ID, Title and Author(s)
9.00 – 9.15 am	**S6018 - Improving Indoor Air Quality from Effective Ventilation Systems in Office Buildings in Sri Lanka** *K. W. D. K. C. Dahanayake and Chitra Weddikkara*
9.15 – 9.30 am	**S6039 - Enablers and Barriers of Implementing ISO 50001- Energy Management Systems (EnMS) in Sri Lankan Context** *S. B. R. G. K. Samarakoon and P. A. D. Rajini*
9.30 – 9.45 am	**S6046 - Impact of Maintenance Management Procedures on Energy Efficiency of Chillers** *M. R. Siriwardana, Nayanathara De Silva and R. A. G. Nawarathna*
9.45 – 10.00 am	**S6061 - Developing a Maintenance Strategy Plan to Improve Energy Efficiency of HVAC System** *S. S. Fernando, Nayanathara De Silva and K. W. D. K. C. Dahanayake*
10.00 – 10.30 am	**Q&A**

Saturday, 15 June 2013

Session 3C

Theme	:	**Procurement and Integrated Project Delivery**
Session Chair	:	Mr. Indunil Seneviratne
Coordinator	:	Ms. Gayani Konara
Venue/Time	:	Queens Court – 9.00 am – 10.30 am

Time	Paper ID, Title and Author(s)
9.00 – 9.15 am	**S6013 - Automation of BIM Quantity Take-Off to Suit QS's Requirements** *Mayouran Wijayakumar and Himal Suranga Jayasena*
9.15 – 9.30 am	**S6069 - Comparative Effectiveness of Quantity Surveying in a Building Information Modelling Implementation** *Gemunu Kulasekara, Himal Suranga Jayasena and K. A. T. O. Ranadewa*
9.30 – 9.45 am	**S6016- The Need for an Integrated Cost Modelling Framework for Building Information Modelling** *Ramadha De Silva and Himal Suranga Jayasena*
9.45 – 10.00 am	**S6032 - Assessing the BIM Maturity in a BIM Infant Industry** *Himal Suranga Jayasena and Chitra Weddikkara*
10.00 – 10.30 am	**Q&A**

Saturday, 15 June 2013

Session 4A

Theme	:	**Sustainable Construction and Green Buildings**
Session Chair	:	Prof. Rohinton Emmanuel
Coordinator	:	Mrs. Kanchana Perera
Venue/Time	:	Dukes Court 1 – 11.00 am – 1.00 pm

Time	Paper ID, Title and Author(s)
11.00 – 11.15 am	**S6012 - A Framework for Environmental Rating Schemes for Infrastructure Projects** *Thilini Shiromani Jayawickrama, George Ofori and Low Sui Pheng*
11.15 – 11.30 am	**S6007 - Comparative Study of Green Building Rating Systems: In Terms of Water efficiency and Conservation** *K. G. A. S. Waidyasekara, M. L. De Silva and R. Rameezdeen*
11.30 – 11.45 am	**S6036- Importance of Occupants' Expectations for Acceptance of Green Buildings: A Literature Review** *B. H. Mallawaarachchi and M. L. De Silva and R. Rameezdeen*
11.45 – 12.00 pm	**S6037- An Evaluation of the Outcomes of the Urban Development Plans with Special Reference to Moratuwa Urban Development Plan** *T. K. G. P. Ranasinghe and M. Lalith De Silva*
12.00 – 12.15 pm	**S6044 - Cool Pavement Systems as A Mitigation Strategy of Urban Heat Island Effect: A Literature Review** *Ashan Asmone, S. R. Chandrathilake and K. A. T. O. Ranadewa*
12.15 – 12.30 pm	**S6065- Applicability of Socio-Economic Factors in Sustainable Construction for Sri Lankan Context** *A. M. D. C. Amarakoon , S. R. Chandrathilake and R. A. G. Nawarathna*
12.30 – 1.00 pm	**Q&A**

Saturday, 15 June 2013

Session 4B

Theme	:	**Sustainable Materials and Technologies**
Session Chair	:	Prof. Ranjith Dissanayake
Coordinator	:	Dr. Nayanthara de Silva
Venue/Time	:	Dukes Court 2 - 11.00 am – 1.00 pm

Time	Paper ID, Title and Author(s)
11.00 – 11.15 am	**S6003 - Techno-economic Feasibility of Integration of Green Technologies for Affordable Housing** *S. P. Raut, S. A. Mandavgane, M. V. Madurwar and R. V. Ralegaonkar*
11.15 – 11.30 am	**S6051 - Developing a Framework for Selection of Sustainable Materials Based on the Embedded Energy for Building Construction** *S. B. R. Senarath, S. R. Chandrathilake and M. F. Victoria*
11.30 – 11.45 am	**S6070- Primary Study of the Impact of In-Situ and Factory Products in Sri Lankan Construction Industry** *Manoj Thudugala and L. D. Indunil P. Seneviratne*
11.45 – 12.00 pm	**S6004 - Use of Recycle Paper Mill Residue and Fly Ash in Production of Waste-Create Bricks** *S. P. Raut, R. V. Ralegaonkar, S. A. Mandavgane and Mangesh Madurwar*
12.00 – 12.15 pm	**S6006- Use of Recycled Aggregates in Structural Concrete** *E. S. Y. Premasiri, A. B. Y. Kariapper, A. M. G. G. M. B. Abeysinghe and S. Karunaratne*
12.15 – 12.30 pm	**S6009- Use of Sustainable Materials in Construction Industry Contractor's Perspective** *I. M. Chethana S. Illankoon, K. G. A. S. Waidyasekara and W. P. S. Karunadasa*
12.30 – 1.00 pm	**Q&A**

Saturday, 15 June 2013

Session 4C

Theme	:	**Procurement and Integrated Project Delivery**
Session Chair	:	Mr. Indunil Seneviratne
Coordinator	:	Ms. Gayani Konara
Venue/Time	:	Queens Court - 11.00 am – 1.00 pm

Time	Paper ID, Title and Author(s)
11.00 – 11.15 am	**S6015 - Ability of BIM to Satisfy CAFM Information Requirements** *Mehala Gnanarednam and Himal Suranga Jayasena*
11.15 – 11.30 am	**S6014 - Identification of a Technological Framework for Implementing Building Information Modelling in Sri Lanka** *Kasun Gunasekara and Himal Suranga Jayasena*
11.30 – 11.45 am	**S6075- The Reshuffle of Contractual Liabilities by Implementing Integrated Project Delivery (IPD) in Building Information Modelling (BIM) Based Construction** *Ishara Kasun Madusanka and Himal Suranga Jayasena*
11.45 – 12.00 pm	**S6022 - The Reshuffle of Risks from Implementing BIM Based Integrated Project Delivery in Sri Lankan Construction Industry** *Anuradha Abeyratne and Himal Suranga Jayasena*
12.00 – 12.15 pm	**S6067- Building Information Modelling and Future Quantity Surveyor's Practice in Sri Lankan Construction Industry** *Gayathri Nagalingam, Himal Suranga Jayasena and K. A. T. O. Ranadewa*
12.15 – 12.30 pm	**S6027- Effects of Premature Termination: Case Studies of Sri Lankan Construction Projects** *D. N. Abeynayake and R. N. M. U. Kumara*
12.30 – 1.00 pm	**Q&A**

Abstracts of the Proceedings of the Second World Construction Symposium 2013

Theme:
Socio-Economic Sustainability in Construction: Practice, Policy and Research

Edited by:
Dr. Y. G. Sandanayake
Dr. N. G. Fernando

Building Economics and Management Research Unit (BEMRU)
Department of Building Economics
University of Moratuwa

CONTENTS OF ABSTRACTS

A Framework for Environmental rating schemes for infrastructure projects 41
Thilini Shiromani Jayawickrama, George Ofori and Low Sui Pheng

Ability of BIM to Satisfy CAFM Information Requirements 42
Mehala Gnanarednam and Himal Suranga Jayasena

An Evaluation of the Outcomes of the Urban Development Plans with Special Reference to Moratuwa Urban Development Plan 43
T. K. G. P. Ranasinghe and M. Lalith De Silva

Applicability of Socio-Economic Factors in Sustainable Construction for Sri Lankan Context 44
A. M. D. C. Amarakoon, S. R. Chandrathilake and R. A. G. Nawarathna

Application of the Safe Working Cycle (SWC) in Hong Kong Construction Industry: Literature Review and Future Research Agenda 45
Daniel W. M. Chan and Henry T. W. Hung

Approach to Sustainable Development through Architectural Education: Insight to the Perceptions of Sri Lankan Students 46
Marini Samaratunga

Assessing the BIM Maturity in a BIM Infant Industry 48
Himal Suranga Jayasena and Chitra Weddikkara

Automation of BIM Quantity Take-Off to Suit QS's Requirements 49
Mayouran Wijayakumar and Himal Suranga Jayasena

Building Information Modelling and Future Quantity Surveyor's Practice in Sri Lankan Construction Industry 50
Gayathri Nagalingam, Himal Suranga Jayasena and K. A. T. O. Ranadewa

Common Errors that are being made in Preparing and Pricing BOQ in Sri Lankan Construction Industry 51
A. A. Uthpala Shammi Gunathilaka and L. D. Indunil P. Senevirathne

Comparative Effectiveness of Quantity Surveying in a Building Information Modelling Implementation 52
Gemunu Kulasekara, Himal Suranga Jayasena and K. A. T. O. Ranadewa

Comparative Study of Green Building Rating Systems: In Terms of Water efficiency and Conservation 53
K. G. A. S. Waidyasekara, M. L. De Silva and R. Rameezdeen

Contribution of Building Management System towards Sustainable Built Environment 54
W. H. C. D. Kumara and K. G. A. S. Waidyasekara

Cool Pavement Systems as A Mitigation Strategy of Urban Heat Island Effect: A Literature Review 55
Ashan Asmone, S. R. Chandrathilake and K. A. T. O. Ranadewa

Coping with Ethical Dilemmas in a Socially Responsible Manner – Quantity Surveyors' Perspective 56
Dineth Kalukapuge and L. D. Indunil P. Seneviratne

Developing a Framework for Selection of Sustainable Materials Based on the Embedded Energy for Building Construction 57
S. B. R. Senarath, S. R. Chandrathilake and M. F. Victoria

Developing a Maintenance Strategy Plan to Improve Energy Efficiency of HVAC System 58
S. S. Fernando, Nayanathara De Silva and K. W. D. K. C. Dahanayake

Development Supportive Novel Trends and Practices for Construction Sector 59
Jayanga Denagama and Chandanie Hadiwattege

Effective Fire Safety Planning for Industrial Buildings: A Literature Review 60
A. M. S. U. Athapaththu, Nirodha Gayani Fernando and D. M. P. P. Dissanayake

Effects of Premature Termination: Case Studies of Sri Lankan Construction Projects 61
D. N. Abeynayake and R. N. M. U. Kumara

Enablers and Barriers of Implementing ISO 50001- Energy Management Systems (EnMS) in Sri Lankan Context 62
S. B. R. G. K. Samarakoon and P. A. D. Rajini

E-Tendering Framework for Public Procurement in Sri Lanka 63
Piyadasun Amarapathy, Himal Suranga Jayasena and K. A. T. O. Ranadewa

Factors Affecting Environmental Health and Safety in Healthcare Sector 64
Brinda Saranga and Damitha Rajini

Frequently Challenged Determinations of the Engineer in Sri Lankan Construction Contracts 65
Himal Suranga Jayasena, Gihan Geethanath Seram and Jery Johnson

Identification of a Technological Framework for Implementing Building Information Modelling in Sri Lanka 66
Kasun Gunasekara and Himal Suranga Jayasena

Impact of Government Policies and Regulations when Adopting Alternative Procurement Methods 67
Chamal Wijewardana, Himal Suranga Jayasena and K.A.T.O. Ranadewa

Impact of Maintenance Management Procedures on Energy Efficiency of Chillers 68
M. R. Siriwardana, Nayanathara De Silva and R. A. G. Nawarathna

Importance of Occupants' Expectations for Acceptance of Green Buildings: A Literature Review 69
B. H. Mallawaarachchi and M. L. De Silva and R. Rameezdeen

Improving Indoor Air Quality from Effective Ventilation Systems in Office Buildings in Sri Lanka 70
K. W. D. K. C. Dahanayake and Chitra Weddikkara

Influence of Change Management for Effective Outsourcing of Facilities Management Services 71
Pournima Sridarran and Nirodha Gayani Fernando

In-House versus Outsourcing Facilities Management: A Framework for Value-Added Selection in Sri Lankan Commercial Buildings 72
M. H. S. Ahamed, B. A. K. S. Perera and I. M. C. S. Illankoon

Integrated Facilities Management Practices in Sri Lanka: A Preliminary Investigation 73
R. P. N. P. Weerasinghe and Y. G. Sandanayake

Overcoming Sustainability Issues through Financial Risk Management in Private Finance Initiative Projects 74
U. T. Withanachchi and Nirodha Gayani Fernando

Plant and Equipment Management to Minimize Delays in Road Construction Projects 75
Sri Nuwan Randunupura and Chandanie Hadiwattege

Primary Study of the Impact of In-Situ and Factory Products in Sri Lankan Construction Industry 76
Manoj Thudugala and L. D. Indunil P. Seneviratne

Psychological Contract with Construction Labour for Sustainability in Construction 77
L. L. Ekanayake and S. A. V. N. Chandradasa

Relationally Integrated Value Networks for Sustainable Procurement 78
Sachithra Weerapperuma, Nayanathara De Silva, Mohan Kumaraswamy and Malik Ranasinghe

Role of Academic Research in Sustainable Construction Practice 79
Chandanie Hadiwattege, Nirodha Fernando and Sepani Senaratne

Search for Key Performance Indicators (KPIs) for Target Cost Contracts in Hong Kong 80
Daniel W. M. Chan and Joseph H. L. Chan

Special Features, Experiences and New Trends in Arbitration in the Construction Industry of Sri Lanka 81
Mahesh Abeynayake and Chitra Weddikkara

Stakeholders' Preference Towards the Use of Conflict Management Styles in Dual Concern Theory in Post Contract Stage 82
M. A. C. L. Gunarathna and Nirodha Gayani Fernando

Strengthening the Safety Culture for Organizational Sustainability 83
N. H. C. Manjula and Nayanthara De Silva

Techno-economic Feasibility of Integration of Green Technologies for Affordable Housing 84
M. V. Madurwar, R. V. Ralegaonkar, S. A. Mandavgane and S. P. Raut

The Need for an Integrated Cost Modelling Framework for Building Information Modelling 85
Ramadha De Silva and Himal Suranga Jayasena

The Reshuffle of Contractual Liabilities by Implementing Integrated Project Delivery (IPD) in Building Information Modelling (BIM) Based Construction 86
Ishara Kasun Madusanka and Himal Suranga Jayasena

The Reshuffle of Risks from Implementing BIM Based Integrated Project Delivery in Sri Lankan Construction Industry 87
Anuradha Abeyratne and Himal Suranga Jayasena

Use of Recycle Paper Mill Residue and Fly Ash in Production of Waste-Create Bricks 88
S. P. Raut, R. V. Ralegaonkar, S. A. Mandavgane and Mangesh Madurwar

Use of Recycled Aggregates in Structural Concrete 89
E. S. Y. Premasiri, A. B. Y. Kariapper, A. M. G. G. M. B. Abeysinghe and S. Karunaratne

Use of Sustainable Materials in Construction Industry Contractor's Perspective 90
I. M. Chethana S. Illankoon, K. G. A. S. Waidyasekara and W. P. S. Karunadasa

Utility Factors Affecting for Selecting Delay Analysis Technique 91
H. M. C. K. Sudeha, B. A. K. S. Perera and I. M. C. S. Illankoon

Viability of Private Sector Involvement in Infrastructure Project Development in Developing Country 92
Samanthi Manoja Tanabe and Malik Ranasinghe

PAPER ABSTRACTS

A FRAMEWORK FOR ENVIRONMENTAL RATING SCHEMES FOR INFRASTRUCTURE PROJECTS

Thilini Shiromani Jayawickrama*, George Ofori and Low Sui Pheng
Department of Building, National University of Singapore, Singapore

ABSTRACT

Infrastructure plays a vital role in a country's socioeconomic development and there is a growing demand for infrastructure in developing countries. However, infrastructure development impacts the natural environment significantly. Therefore, it is important to consider the environmental sustainability of infrastructure projects. In the built environment sector, Environmental Rating Schemes (ERS) play an important role in evaluating and encouraging the implementation of sustainability at the project level. While ERSs have gained widespread attention worldwide, less attention has been paid to infrastructure, and it has tended to focus on the building sector. Furthermore, no ERSs for infrastructure are found in developing countries so far. It is important for an ERS to be type-specific and many building rating schemes have considered this. However, no type-specific ERS for infrastructure has been published so far. Moreover, the existing ERSs have been criticized for the absence of any theoretical bases. To address these gaps, this study aims to propose a theoretical framework for infrastructure ERSs in developing countries. The literature on environmental sustainability was reviewed to identify the important aspects which should be applied at the project level to achieve environmental sustainability in those countries. The factors were analyzed using Analytic Hierarchy Process (AHP). Results show the highest importance for minimising impacts of waste disposal and non-renewable energy sources followed by avoiding corruption. The study provides a theoretical basis for developing ERSs for infrastructure projects and a path for developing sector-specific ERSs.

Keywords*: Developing Countries; Environmental Rating Schemes (ERSs); Infrastructure Projects.*

*Corresponding Author: e-mail - a0066405@nus.edu.sg

ABILITY OF BIM TO SATISFY CAFM INFORMATION REQUIREMENTS

Mehala Gnanarednam* and Himal Suranga Jayasena
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Facilities Management (FM) and Building Information Modelling (BIM) are contemporary day concepts that have modernised the way built environment behave. In modern day, FM concepts are moving towards to sustainable FM (SFM). Incidentally, Facilities Managers (FMs) become responsible for assuring the sustainability of facilities of the business. Modern day buildings are increasingly sophisticated and the need for information to operate and maintain them in sustainable manner is vital. Currently FMs rely on the information of the facility retrieved from conventional Computer Aided FM (CAFM). However, FM professionals face challenges from existing information inefficiencies resulting in unnecessary costs, productivity, efficiency and effectiveness losses where these leads to failure of SFM. Considering its favourable features, BIM had been identified as promising solution to effectively reach SFM goals. BIM conceptually has been developed to overcome the inefficiencies in conventional building information systems and recording methods. Combined data would enable the art of making any building more intelligent and sustainable. Significant efforts were found which had focused on getting the benefit of BIM for FM. However, there was no certain answer to "how far could BIM satisfy the information needs of CAFM?'' This paper proposes a methodology to theoretically answer this question, which had been proposed for the next step of the study being conducted in Sri Lanka.

Keywords: *Building Information Modelling (BIM); Computer Aided Facilities Management (CAFM); Facilities Managers (FMs); Sustainable Facilities Management (SFM).*

* Corresponding Author: e-mail - mehala@bimlab.net

AN EVALUATION OF THE OUTCOMES OF THE URBAN DEVELOPMENT PLANS WITH SPECIAL REFERENCE TO MORATUWA URBAN DEVELOPMENT PLAN

T. K. G. P. Ranasinghe*
Department of Town and Country Planning, University of Moratuwa, Sri Lanka

M. L. De Silva
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Plan outcome evaluation (POE) is very significant rather than focusing on planning process, usefulness of plan, content and quality of plan. POE has been ignored in the field of planning due to lack of proper POE method. This study focuses on the ex post facto evaluation considering the outcomes of action projects of development plans and aim to develop a POE method to evaluate outcomes of development plan towards the achievement of its objectives quantitatively since no one has made such an attempt. Achieving outcomes of development plan directly affect for sustainable urbanisation. A comprehensive literature survey revealed that adaptation of the components of objective driven, theory-driven and theory-based, utilization-driven and theoretical data-driven evaluation methods will lead to overcome related issues on plan outcome evaluation and identified basic four steps suitable to incorporate in any POE method. This developed POE method comprises four steps including mathematical models. Field surveys and questionnaire surveys were carried out to identify public perception on achievement of outcomes of action projects. Developed POE method can be used as a progress monitoring tool and as an outcome evaluation tool. This POE method will be a useful tool for planners, project managers and policy makers to improve planning practices and provide necessary knowledge for revising plans in order to ensure the sustainable urbanisation. This study can be extended to evaluate the outcomes of development plan when objectives are clear and measurable further considering theory, process and objectives driven methods.

Keywords: *Outcomes of Development Plan; POE Method; Public Perception.*

* Corresponding Author: e-mail - gayaniprasadika@gmail.com

APPLICABILITY OF SOCIO-ECONOMIC FACTORS IN SUSTAINABLE CONSTRUCTION FOR SRI LANKAN CONTEXT

A. M. D. C. Amarakoon*, S. R. Chandrathilake and R. A. G. Nawarathna
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

"Sustainability" has emerged as a vibrant field of research and innovation over last few decades. The concept is based on three basic factors; environment, social and economic, namely the Triple Bottom Line. Frequently, the environmental aspect, despite the social and economic aspects, is given a major emphasis in the global arena of sustainable construction. The World Green Building Council (WGBC), being the leading institute in sustainability, has initiated the first step towards assessing the socio economic factors in the field of sustainable construction, which are being neglected in rating green buildings due to its immeasurability as a tool, by developing a framework for assessing the concerns addressed in the Triple Bottom Line. The WGBC criteria presented in seven sections hold concepts developed by the expert panel representing 14 countries, for assessing the social and economic factors. Since the concepts are in contrast with Sri Lankan context, they seek readjustment in order to match Sri Lankan context. Research agenda has commenced with a comprehensive literature survey, followed by expert interviews and a questionnaire survey. The process of developing the theoretical framework to determine the appropriate weightages between each rating has proceeded using the indicators and benchmarks of the available frameworks. Adjusted criteria of the social and economic factors would be able to improve the applicability of GreenSL to assess the green buildings in Sri Lanka. Developed framework through the evaluation process in the research would be capable of assessing the Sri Lankan sustainable constructions in a more appropriate manner, with proper compositional integration of socio-economic and environment factors. A comprehensive assessment of sustainable construction could be achieved through the developed theoretical framework that is fitted in to the Sri Lankan context with due consideration on aspects addressed in Triple Bottom Line; economic, social and environment.

Keywords: *Construction Delays; Delay Analysis Techniques (DAT); Utility Factors.*

*Corresponding Author: e-mail - dinesh_dcs@yahoo.com

APPLICATION OF THE SAFE WORKING CYCLE (SWC) IN HONG KONG CONSTRUCTION INDUSTRY: LITERATURE REVIEW AND FUTURE RESEARCH AGENDA

Daniel W. M. Chan* and Henry T. W. Hung

Department of Building and Real Estate, The Hong Kong Polytechnic University, Hong Kong

ABSTRACT

The accident rate of the Hong Kong construction industry is very high when compared with other developed countries. Since 1990, the industry has introduced different safety initiatives to minimize the occurrence of site accidents, and there has exhibited a significant decrease in accident rate over the years. The Safe Working Cycle (SWC) is one of the effective safety measures aiming to ensure a tidy working site and raise the safety awareness of construction workers everyday. It comprises the Daily Cycle, Weekly Cycle and Monthly Cycle, and it focuses on the causes of construction accidents and improves the overall safety performance on construction sites. This paper will provide a concise introduction of a research project in relation to SWC in the Hong Kong construction industry. It aims to scrutinize the overall research paradigm of a holistic study on the historical development, underlying concepts and applications of SWC in Hong Kong. The investigation will be accomplished by a combination of data collection methods comprised of archival desktop study, in-depth interviews, detailed case studies and an empirical questionnaire survey. Relevant attributes of SWC including the perceived benefits, potential difficulties and effective recommendations for future implementation will be explored and discussed herein. The research findings are expected to help the decision-makers to generate clearer insights into the effectiveness of SWC in improving site safety, and to allow industrial practitioners to explore whether and how the site accidents can be mitigated via SWC.

Keywords: *Construction Industry; Hong Kong; Safe Working Cycle; Safety Measure; Site Safety Performance.*

* Corresponding Author: e-mail - daniel.w.m.chan@polyu.edu.hk

APPROACH TO SUSTAINABLE DEVELOPMENT THROUGH ARCHITECTURAL EDUCATION: INSIGHT TO THE PERCEPTIONS OF SRI LANKAN STUDENTS

Marini Samaratunga*
Department of Architecture, University of Moratuwa, Sri Lanka

ABSTRACT

Sustainable development is considered as a multi-dimensional problem for integration of economic, environmental, institutional, political, social and personal human problems. Therefore, interdisciplinary interaction will be essential to reach the ultimate goals of sustainability. Architecture, as a key profession in the construction sector, plays a significant role in promoting the interdisciplinary interaction and a holistic approach to sustainable development. This approach requires a high amount of knowledge, skills and attitude which could be obtained through architectural education.

The need of approaching sustainable development through education was accepted by the United Nations and has declared 2005 to 2014 as the decade of Education for Sustainable Development (ESD). Therefore, this paper intends to explore the relationship between the architectural education and sustainable design practice in the Sri Lankan context.

Architectural educational content on sustainable development has two folds, such as, the technical component and non-technical component. The technical components mainly focus on providing knowledge and skills, which are more applicable towards the latter parts of the design process (design detailing). Non-technical components not only provide knowledge and skills but also attitude and could be applied from the early stages of the design process (Concept development, brief interpretation, etc).

The methodology adopted is a survey (structured) research approach where data generated through a social survey and a literature survey would be analysed to reflect some thoughts. Social survey would be conducted through a structured questionnaire given to undergraduates and young practitioners of architecture from the two main schools of Architecture in Sri Lanka (City School of Architecture, Colombo and Department of Architecture, University of Moratuwa). Student perception on Sustainability would be explored through the parameters of personal interpretations, application frequency and satisfaction to non-satisfaction ratio. Reflections would include that the technical

* Corresponding Author: e-mail - marini_samaratunga@yahoo.com

knowledge and skills need to be in equilibrium with the non-technical knowledge and attitudes given in architectural education to obtain a more holistic sustainable design approach.

Keywords: Architectural Design; Architectural Education; Education for Sustainable Development (ESD); Sri Lankan Architecture Student Perception; Sustainable Development.

ASSESSING THE BIM MATURITY IN A BIM INFANT INDUSTRY

Himal Suranga Jayasena* and Chitra Weddikkara
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Building Information Modelling (BIM) is rapidly gaining acceptance of building industries internationally, and is likely to become the primary industry standard for AEC information exchange in near future. The built-in intelligence of BIM offers the highest potentials for adopting lean approaches for project delivery, and minimizing of risks and uncertainties; enabling highly sustainable procurement systems for the building industry. While it is accepted that BIM is in its infant stage in Sri Lanka and BIM technologies are rarely present, adoption of BIM has been identified to be timely. Use of inappropriate BIM adoption strategies would waste valuable resources and time. This will also hinder the industry acceptance of BIM. Development of reliable strategies requires information on current BIM maturity in order to identify the gaps. Wider gaps in a BIM infant industry give rise to the number of potential alternative BIM adoption strategies. Thus, a coherent assessment of current context is crucial to chose most suitable strategies. Bew-Richards BIM Maturity Model and Succar's BIM Maturity Stages were the widely referred models used to ascertain the BIM maturity of an industry or an organization. However, these were found to be less useful to assess a BIM infant industry. The study proposes framework comprising four components, viz. collaborative processes, enhanced skill, integrated information and automated systems, and knowledge management.

Keywords: *Building Information Modelling (BIM); BIM Adoption; BIM Maturity.*

* Corresponding Author: e-mail - suranga@uom.lk

AUTOMATION OF BIM QUANTITY TAKE-OFF TO SUIT QS'S REQUIREMENTS

Mayouran Wijayakumar* and Himal Suranga Jayasena
Department of Building Economics, University of Moratuwa, Sri Lanka.

ABSTRACT

Building Information Modelling (BIM) is a thriving technology which laid potential to address problems in conventional practices based on Computer-Aided Design (CAD) drawings. Sustainability and complexity of today's buildings are insist BIM technology and associated processes to develop for project delivery through sustainable procurement systems. Quantity Take-Off (QTO) is vitally important task in any building project since measurement practice applied to buildings has to be both accurate and consistent for auditing a building project from many different perspectives. However conventional QTO methods are tedious and error-prone. Major portion of Quantity Surveyor's time is spent for QTO. BIM QTO tools are task specific software applications delivering great promise to automate the extraction of quantities from BIM models. Visual building QTO improves productivity and accuracy that leads to sustainable QS practices. The time saving offered by these technologies will allow the Quantity Surveyor to focus more on other value adding services. However the automated outputs must suit the Quantity Surveyors' requirements in order to be effectively useful. Otherwise, the reliance on such technologies could result in such consequences, deviate from sustainability. This research is focused on "How far BIM QTO tools can automate QTO to suit QS's requirements?" The findings will contribute to the knowledge by establishing the status contribution of BIM for QTO being a primary function of Quantity Surveying within the overall sustainable procurement systems anticipated for the building industry.

Keywords: Automation; Building Information Modelling (BIM); BIM Tools; New Rules of Measurement (NRM) Quantity Surveyor (QS); Quantity Take-Off (QTO).

* Corresponding Author: e-mail - mayouran@bimlab.net

BUILDING INFORMATION MODELLING AND FUTURE QUANTITY SURVEYOR'S PRACTICE IN SRI LANKAN CONSTRUCTION INDUSTRY

Gayathri Nagalingam*, Himal Suranga Jayasena and
K. A. T. O. Ranadewa
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Sustainability has been an often mentioned goal of businesses, non-profit organizations and governments in the past decade, yet measuring the degree to which an organization is being sustainable or pursuing sustainable growth can be difficult. Building Information Modelling (BIM) is a new paradigm in the thriving Sustainable construction industry, from which the triple bottom line of the Sustainability can be greatly achieved. As the significance of BIM has become increasingly appreciated, most of the activities in the building industry have focused on BIM with sustainable design strategies. BIM has a great potential for integration into construction projects life cycle which will lead to pave the way towards becoming the industry standards for construction projects. Hence BIM would be a key tool in the project procurement in the future. However, BIM is not yet implemented in Sri Lankan construction industry where incorporation of BIM into construction projects life cycle would create differentiation in traditional procurement systems. Consequently, the role of Quantity Surveyors whose building procurement is based on BIM would be revolutionized drastically from the existing role where BIM permits to analyse the building, the structure, materials and performance in real time as it is being designed. Hence, a research is conducted with broader aim of exploring the potential expansions of QS roles, changing key roles and responsibilities of future Quantity Surveyors in a sustainable BIM based project delivery in Sri Lanka, which will lend a hand in training Quantity Surveyors to face future challenges. This paper contains the preliminary findings of a literature review conducted on the current key roles and responsibilities of Quantity Surveyors in local building procurement and future expectations in a BIM based project delivery.

Keywords: *Building Information Modelling; Quantity Surveying; Sri Lanka; Sustainability.*

* Corresponding Author: e-mail - gayuqs@yahoo.com

COMMON ERRORS THAT ARE BEING MADE IN PREPARING AND PRICING BOQ IN SRI LANKAN CONSTRUCTION INDUSTRY

A. A. Uthpala Shammi Gunathilaka* and L. D. Indunil P. Senevirathne
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

In construction projects the Bill of Quantities (BOQ) has become a vital document in post contract stage as well as in pre contract stage, since the BOQ address the important three aspects of a project, that are time, cost and quality. Therefore, it is necessary to illustrate that if there is any error in BOQ that would directly affect the base of the construction projects. As a result, all stakeholders involved in a project have an extremely higher concern on those three aspects, as having an error free BOQ is vitally important. Errors can occur during preparation stage and pricing stage of the BOQ. Further, to minimize BOQ errors it is important to have a clear understanding on the errors which occur most frequently during preparing and pricing stages of a BOQ. Therefore, this research study is focused to identify the common errors that are being made in preparing BOQ in Sri Lankan construction industry. A literature survey was carried out to identify the importance and common errors of BOQ during preparation and pricing BOQ in construction industry and this paper presented the findings of it. The survey revealed the importance of BOQ in post contract stage as well as in pre contract stage. Moreover this research has identified the errors which occurred during preparation and pricing stages of BOQ separately, and the reasons for those errors. This would then lead to establish a mechanism to, either to eradicate or minimize errors in BOQ preparation and pricing within the construction industry and hence facilitate to sustain the BOQ as an important and reliable document in the industry.

Keywords: *Bill of Quantities (BOQ); Cost; Errors; Quality; Time.*

* Corresponding Author: e-mail - uthpalagunathilaka@yahoo.com

COMPARATIVE EFFECTIVENESS OF QUANTITY SURVEYING IN A BUILDING INFORMATION MODELLING IMPLEMENTATION

Gemunu Kulasekara*, Himal Suranga Jayasena and
K. A. T. O. Ranadewa
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Over the past eras, growths of innovative technological concepts are promptly increasing, in order to achieve competitive productivity and performance. Building industry identifies technology as vital. Although the building industry is broadly identified as unique and conservative, at the same time construction industry has to have varied according to these innovative technological variations. In addition to that these technological variations may have potential to influence everyone's professions in different ways. Although, the concept of Building Information Modelling (BIM) is not practiced in Sri Lankan construction industry yet, it is likely to become the project delivery standard in future. Introduce with the vision "sustainability by building smarter", BIM will improve the performance of building professionals. The current knowledge does not adequately explain how the functions of a Quantity Surveyor are affected by BIM. This paper presents a study on comparative effectiveness offered by BIM for the traditional functions of a Quantity Surveyor. The study is interesting because the new knowledge will help to develop strategies for professional development and update the education curricula to train the Quantity Surveyors to face future challenges.

Keywords: *Building Industry; Building Information Modelling; BIM; Quantity Surveying; Sri Lanka.*

*Corresponding Author: e-mail - gammaq88@gmail.com

COMPARATIVE STUDY OF GREEN BUILDING RATING SYSTEMS: IN TERMS OF WATER EFFICIENCY AND CONSERVATION

K. G. A. S. Waidyasekara* and M. L. De Silva
Department of Building Economics, University of Moratuwa, Sri Lanka

R. Rameezdeen
University of South Australia, Adelaide, Australia

ABSTRACT

The construction industry puts a great effort on achieving sustainable development. This is because in the construction industry a lot of natural resources are being consumed. Water is one of the most important natural resources for the development of all economic activities taking place to care for the environment and quality of life in the society. Therefore, availability and management of water resources is essential for a long term sustainability of any country. At present, many environmental assessment tools or green building rating systems developed and accepted by many countries. Simply, green building rating systems provide best standards and assist to fulfil green building practices. Each rating system addressed key sustainable parameters: energy, water, site, indoor environmental quality and materials in order to build sustainable environment.

Since freshwater scarcity has become a global issue, this paper aims to investigate how and in what strategies water efficiency and conservation is discussed in the existing green building rating systems. Primarily, literature review and documentary review were used as the main research method. The eleven green building rating systems which are designed for new construction were considered and were analysed to compare in terms of the key requirements/strategies and credits awarded for water efficiency and conservation in the rating systems. It was found that in terms of water, intention of each rating system is to reduce potable water consumption compared to the benchmark buildings. It further address in many directions to conserve and monitor water throughout the project life cycle. However, few rating systems have only addressed water conservation and water pollution during the construction phase. Furthermore, the paper enables to analyse the priority given for the water efficiency compared to other sustainable parameters.

Keywords: *Construction Industry; Green Rating Systems; Sustainable Development; Water Efficiency and Conservation.*

* Corresponding Author: e-mail - anuradha@uom.lk

CONTRIBUTION OF BUILDING MANAGEMENT SYSTEM TOWARDS SUSTAINABLE BUILT ENVIRONMENT

W. H. C. D. Kumara* and K. G. A. S. Waidyasekara
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

The biggest challenge faced by the community is controlling and monitoring the performance of built environment facilities in a sustainable way. From this dimension, effective use of Building Management System (BMS) in the built environment is representing a significant strategy in relation to economic, environment and social perspectives. Higher energy efficiency, lower operating and maintenance costs, better indoor air quality, greater occupant comfort and productivity are the major achievements of a successful BMS. Therefore, at present it is so evident that, many organizations are enthusiastic to allocate a substantial investment, in order to, install, commissioning, operation and maintenance of BMS. However, to obtain the optimum use of BMS is still challenging among the building users. Thus, the requirement of developing a framework for functionality of BMS is essential in order to gain maximum benefits through operating building automation and control systems.

The aim of the paper is to investigate the contribution of BMS in achieving a sustainable built environment. The findings are achieved through conducting literature and documentary review available in the built environment and analyzing green building rating systems to find out the input of BMS towards sustainable built environment. Therefore, comparative study conducted between LEED, BREEAM and GreenSL rating systems. Based on the findings, theoretical framework was developed to facilitate contribution of BMS in sustainable development. Moreover, the paper is engaged in analysing the credit contribution of BMS in order to gain the green rating certification.

Keywords: *Building Management System; Green Building Assessment Tools: Sustainable Built Environment.*

* Corresponding Author: e-mail - kchamaradimuthu@gmail.com

COOL PAVEMENT SYSTEMS AS A MITIGATION STRATEGY OF URBAN HEAT ISLAND EFFECT: A LITERATURE REVIEW

Ashan Asmone*, S. R. Chandrathilake and K. A. T. O. Ranadewa
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

The urban heat island effect is the rise of ambient temperature in urban areas due to the progressive replacement of natural surfaces. Buildings and paved surfaces are contributing most to this phenomenon as per the properties of their material. Conversely, urban heat islands have a direct influence on building occupants' comfort levels, building cooling loads and energy costs as well. Although there are existing researches on green buildings, there is a significant lack of literature on cooler paved surfaces; particularly in tropical countries.

To bridge this research gap, and to explore the applicability of cooler pavement systems in search of mitigating urban heat island effect in the micro and meso level, this study was executed as a desk study based on a literature survey of environmental implications of unsustainable rapid urban development, their mitigation strategies, and where existing pavement systems stood in all this. The literature synthesis of existing work by authors from around the globe led to the discussion and analysis of the paper, and resultant further study areas.

This paper compares alternative "cool" pavement systems, which are defined as pavements with improved solar reflectivity and permeability characteristics. The paper suggests how these can be used effectively in a sustainability conscious building facility, and by infrastructure developments which has a wider role of reducing local heat islands, increasing pedestrian comfort and reducing runoff water. The scope of this paper was limited to pedestrian pavements and gives reference to construction professionals who are engaged with sustainable building and infrastructure projects on their usability.

Keywords*: Green Building Materials; Pedestrian Pavements; Sustainability; Urban Heat Island Effect.*

*Corresponding Author: e-mail - asmone@outlook.com

COPING WITH ETHICAL DILEMMAS IN A SOCIALLY RESPONSIBLE MANNER - QUANTITY SURVEYORS' PERSPECTIVE

Dineth Kalukapuge* and L. D. Indunil P. Seneviratne
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Ethics is a vital constituent for any profession. Therefore, professions are governed via codes of practice published by respective professional bodies as a measure of ensuring compliance of members with professional ethics. These codes necessarily reflect social interests. Recognized professional organizations with regards to Quantity Surveying profession (RICS, AIQS, IQSSL, etc.) have introduced Codes of Professional Conduct which define the standard of professional conduct to which the members must adhere as socially responsible individuals. In a context these codes have not been successfully able to achieve comprehensive social responsibility within the practice of respective members, this study attempts to understand the grounds for ethical/unethical behaviour, ethical dilemmas and action taken by QSs in the face of an ethical dilemma within professional practice. Frequent ethical dilemmas as well as contemporary developments, such as the predicament brought in by sustainability concept, have been identified by the study to be elements that need addressing. Findings of the literature review exhibit conclusive evidence about a strong relationship among QSs' practical execution; and knowledge and experience. The study concludes with an emphasis on the need for improving education and discussion of ethics as well as social responsibility necessitated by the broader society.

Keywords: *Ethical Dilemma; Ethics; Quantity Surveying; Social Responsibility; Sustainability.*

* Corresponding Author: e-mail - ddkalu@yahoo.com

DEVELOPING A FRAMEWORK FOR SELECTION OF SUSTAINABLE MATERIALS BASED ON THE EMBEDDED ENERGY FOR BUILDING CONSTRUCTION

S. B. R. Senarath
KEO International Consultants, Doha, Qatar

S. R. Chandrathilake and M. F. Victoria*
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Material selection in conventional construction projects concentrate on various criteria. However, sustainable construction must take into account of embodied energy of materials during material selection which is rarely addressed by construction professionals. Analysis of embodied energy of construction materials is important as increase in energy consumption will indirectly trigger a series of collisions leading to instability of the environment. Therefore, this research study aims at developing a framework for selection of materials based on embodied energy and other identified main parameters. The study was carried out based on figures retrieved from literature survey as well as on the perceptions of professionals involved in construction through questionnaire survey. The study categorized the identified significant materials based on five major elements (foundation, wall, roof, floor finishes and doors &windows) with two materials per each and evaluated their performance based on the parameters of embodied energy, price, durability and maintainability. According to empirical findings, most of the selected materials of the same element have performed in similar manner on the selected parameter. However, in some selected materials the results for embodied energy has a significant difference with their counterparts which had an impact on the overall score of those materials. Further, even though embodied energy parameter ranked last in the importance weightings, the parameter is of acceptable significance which can have a huge impact on material selection. Ultimately, framework for material selection was developed with the aid of research findings which comprises of four combinations of each of the selected materials with each other in terms of their performance on each individual parameter and on overall performance.

Keywords: *Embodied Energy; Material Selection; Sustainable Construction.*

* Corresponding Author: e-mail - michele.floren@gmail.com

DEVELOPING A MAINTENANCE STRATEGY PLAN TO IMPROVE ENERGY EFFICIENCY OF HVAC SYSTEM

S. S. Fernando, Nayanathara De Silva and K. W. D. K. C. Dahanayake*
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

In managing energy in buildings, a greater focus has been given to the HVAC system as it generally consumes more than 50% of total energy usage in buildings. Proper maintenance had been identified as a significant factor to improve energy efficiency of HVAC systems. For instance a proper maintenance plan can save 5% - 20% of energy bills without a significant capital investment. Thus, the research aims to develop a maintenance strategic plan to improve energy efficiency of HVAC systems. Survey technique was adapted to collect data on HVAC system failures, impact of failures, frequency of each failure, significance of causes for failures and HVAC Maintenance requirements to ensure efficiency. A statistical analysis was carried out to develop a maintenance strategy plan. Maintenance strategic plan is proposed by using the preventive and predictive maintenance strategy. This proposed plan may be useful for building managers to manage energy by adopting efficient maintenance strategies.

Keywords: *Energy Efficiency; HVAC System; Maintenance; Predictive Maintenance; Preventive Maintenance.*

* Corresponding Author: e-mail- kdahanayake@yahoo.com

DEVELOPMENT SUPPORTIVE NOVEL TRENDS AND PRACTICES FOR CONSTRUCTION SECTOR

Jayanga Denagama and Chandanie Hadiwattege*
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

The rapid development of the technology paved the way towards the new trends and innovations in each and every industry. This is a universal truth which has no any exceptions to the construction industry which faces rapid changes frequently while being one of the major industries of a country that contribute to the living standard of the citizens and to the development of the country.

Sri Lanka being one of the countries with booming economies, it is inevitable to respond to the innovations in world construction industry and there are some important new trends to the development of the industry. Therefore, this research is carried out to address the research gap to identify the important new trends of the Sri Lankan construction industry.

In order to proceed with the research, quantitative research approach was adopted through a questionnaire survey with 90 respondents including clients, contractors and consultants 30 from each. Data were analyzed statistically and were ranked based on the mean value. Out of the nine identified new trends, waste management, sustainability and green building concept and risk management has been identifies as the most important developments over information technology related developments while advanced technological developments were considered with lesser practical applicable value within the Sri Lankan context. Hence, as per the research, it is required to conduct further research studies to acknowledge the time, cost and other benefits can be adopted through facilitating identified innovation and new trends while giving the priority to the high ranked trends identified through this research.

Keywords: *Construction industry; Development; Innovation; New trends; Sri Lanka.*

* Corresponding Author: e-mail - chandanieqs@yahoo.com

EFFECTIVE FIRE SAFETY PLANNING FOR INDUSTRIAL BUILDINGS: A LITERATURE REVIEW

A. M. S. U. Athapaththu*, Nirodha Gayani Fernando and D. M. P. P. Dissanayake

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

The lives and health of human beings, the growth and prosperity of organisation, and the increasing need for fire safety are immediate concerns which provide the original momentum for the business continuity of the organisation. Fire safety consideration should form an important part of any new product or technology development to promote sustainable development, and acceptable solutions to acute fire safety concerns must not pose a threat to the long term development. Simply, the fire safety and sustainable development has common interest in making sure that fire safety is achieved in the most sustainable way. However, the direct property damage to the buildings due to ineffective fire safety planning is increasing with the development of industrialisation and urbanisation. This paper therefore aimed to develop a conceptual model for effective fire safety planning for industrial buildings. A comprehensive literature review was used as the research methodology for this paper. Keywords search for fire accidents causes for fire accidents, fire safety planning and industrial buildings were used to search the literature. The literature findings highlighted that many buildings such as factories do not arrange regular drill; therefore the workers discover themselves in an alien situation whenever an emergency situation arises, causing panic, stampede etc. which further escalate the degree of casualty. Further, accidents are caused mainly due to technical failures and human failures where human failures include lack of awareness of the safety precautions required, inadequate expert knowledge and qualifications in accident prevention. Failure to effective planning for fire safety in buildings can hinder the recovery process, whereas recognition of its importance leads to more efficient use of resources in the wake of emergencies

Keywords: *Fire Safety; Industrial Buildings; Planning.*

*Corresponding Author: email - suranji.athapaththu@gmail.com

EFFECTS OF PREMATURE TERMINATION: CASE STUDIES OF SRI LANKAN CONSTRUCTION PROJECTS

D. N. Abeynayake* and R. N. M. U. Kumara
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Construction projects are inevitable. But they should be in proper way. However some of projects/contracts come to end before their actual completion. This is an adverse effect to the construction industry and it can be identified as a barrier for sustainable construction. Therefore there is a requirement of avoiding occurrence of adverse premature contract/project termination and mitigating their effects while promoting sustainable construction practices. Hence, the aim of the research is to investigate effects of premature contract/project termination before minimizing adverse effects.

In accordance with existing literature, mainly three types of Contract termination can be identified as, termination due to default of client, termination due to default of Contractor and termination for convenience of Employer. But, contract/project terminated prematurely due to whatever reasons, their issues affect on many ways to project stakeholders. Further, less attention is given to some issues relating to project/contract termination like impacts of termination, relationship among parties after termination and steps to prevent premature termination.

This research is conducted through three case studies of terminated construction projects in Sri Lanka. To gather data, semi structured interviews were carried out with professionals and unstructured interviews were held with technical employees. Further, three experts were interviewed to clarify compatibility with termination concept.

The findings were revealed that there are good impacts as well as bad impacts on stakeholders due to premature project/contract terminations. Most of the time, it results in breaking the relationship among parties, creating disputes, blacklisting the contractor...etc. Further, the research is explored good practices for prevent adverse termination effect which can be implemented in construction industry.

Keywords: *Mitigating Termination; Premature Contract Termination; Premature Project termination; Sri Lanka.*

*Corresponding Author: e-mail - dilaniabeynayake@yahoo.com

ENABLERS AND BARRIERS OF IMPLEMENTING ISO 50001-ENERGY MANAGEMENT SYSTEMS (ENMS) IN SRI LANKAN CONTEXT

S. B. R. G. K. Samarakoon and P. A. D. Rajini*
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Energy is critical to organizational operations and can be a major cost to organizations. Besides the economic costs, energy crisis can impose various environmental and societal costs by reducing resources and supporting environmental problems. Especially in buildings, energy is considered as one of the main cost centres for their operations. Considering the importance of managing energy, a number of national, regional and international Energy Management Systems (EnMSs) have been developed to integrate energy efficiency into organisations' management practices while fine-tuning operating processes and improving efficiency of industrial systems. Among them, ISO 50001-EnMS, which was introduced by International Organization of Standardization (ISO) is the most popular system which has been implemented all over the world. However, literature and preliminary studies revealed that there are very few ISO-50001-EnMS applications within Sri Lanka. Hence, there is a little doubt relating to the implementation of ISO 50001-EnMS in Sri Lankan Context. Therefore, the aim of this paper is to critically review the enablers and barriers of implementing ISO 50001-EnMS in Sri Lankan context. A comprehensive literature review, desk study and a preliminary expert survey were employed in achieving the aim of the paper. The research findings identified that financial constraints; lack of experts relating to EnMSs; unawareness on the importance of applicability; complexity of documentation processes; institutional complexities and different cultural aspects as the most critical barriers while identifying the improved organizational image; well-documented energy utilization procedures; regulatory compliances and internal/external recognition and rewards as the key enablers for the implementation of ISO 50001-EnMS in Sri Lanka.

Keywords: *Energy Management; ISO 50001-EnMS; Sri Lanka.*

*Corresponding Author: e-mail – damee_uom@yahoo.com

E-TENDERING FRAMEWORK FOR PUBLIC PROCUREMENT IN SRI LANKA

Piyadasun Amarapathy*, Himal Suranga Jayasena and K. A. T. O.Ranadewa
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

The growth of Information and Communication Technology (ICT) opens new opportunities for businesses all over the world which accelerates the competition among the businesses and professions. Even though good communication is an essential tool for procurement and consultation process, the usage of IT in public procurement in Sri Lankan construction industry is not as much of other sectors, while other developed and developing countries are practicing and gaining advantages. However, adopting e-Tendering in pre contract stage, yields several benefits which can be experienced directly and indirectly. In an economic point of view, e-Tendering enhances the efficiency through transaction cost savings and reduce the direct procurement costs, maintaining transparency, accountability, ease of use and speedy exchange of information including other intangible benefits such as reduced administrative costs. Eventually, e-Tendering will lead to pave the way to reduce the time, cost and resources of a project from which the triple bottom line of the Sustainability can be accomplished to a great extent. This research paper discusses the benefits and challenges in adopting e-Tendering and the legal, technological and material requirements to be appraised in forming a proper framework for e-Tendering. A qualitative research approach is proposed considering the aim and the context of the study.

Keywords: *Construction; e-Tendering; Public Procurement; Sri Lanka; Technology.*

* Corresponding Author: e-mail - piyadasun@gmail.com

FACTORS AFFECTING ENVIRONMENTAL HEALTH AND SAFETY IN HEALTHCARE SECTOR

Brinda Saranga and Damitha Rajini*
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Environmental Health and Safety (EHS) is a discipline, which involves creating a culture of health, safety, and environmental protection in a workplace. It provides workplaces that are injury-free and incident-free for all employees, visitors and contractors, as well as enhances the wellbeing of those parties and local communities. Therefore, EHS has a direct impact on morale of stakeholders, employee productivity as well as on organisational performance. Healthcare facilities are specific from others, and customers and workers in healthcare sector are exposed to huge amount of harmful contaminants compared to other working environments. There are many EHS issues that can be identified in healthcare sector, and inability to control such issues will become an epidemic to the whole society. Various factors determine the EHS condition of an organisation such as ventilation, lighting levels, noise, and design of workstations, safety measures in emergencies, to name few. Having a better understanding on those factors will enable the maintenance of effective EHS practices so that the negative impact of poor EHS practices can be minimized. Hence, the financial goals and objectives of the organisation can be achieved. Even though, such importance is there, studies on EHS is hardly found and a less attention has received to this subject. Therefore, the aim of this paper is to critically evaluate the factors affecting EHS in healthcare facilities. A comprehensive literature review was carried out to identify the EHS factors. Five environmental factors and eight occupational health and safety related factors were identified through the review and they be used to study the critical factors affecting EHS of healthcare facilities in future research agenda.

Keywords: *Environmental Health and Safety (EHS), Environmental Health and Safety Factor; Healthcare Facilities.*

* Corresponding Author: e-mail - damee_uom@yahoo.com

FREQUENTLY CHALLENGED DETERMINATIONS OF THE ENGINEER IN SRI LANKAN CONSTRUCTION CONTRACTS

Himal Suranga Jayasena*
Department of Building Economics, University of Moratuwa, Sri Lanka

Gihan Geethanath Seram
Midmac Contracting, Doha, Qatar

Jery Johnson
EC Harris International, Abu-Dhabi

ABSTRACT

A sustainable procurement system should be capable of delivering a project free of disputes in its ideal perspective. However, disputes seem to be inevitable in construction projects resulting from its complex nature and involvement of different players in a temporary team setup which are conducive for conflicts. Thus, effective strategies to minimize disputes are the best potential contribution towards sustainability. In general, the Engineer is responsible to resolute the conflict since almost all the construction contracts empower the Engineer to give his fair determination in such situations. Better performance of Engineer's fair determination function would no doubt prevent the increase of project costs and time, by avoiding frequent dispute resolution referrals, and eventually minimize the resulting inefficiencies. In that scenario, the Engineer plays an extremely important role in a construction project. However, requirement of giving fair determination of the Engineer has been often debated in recent times. Engineer's determinations are often challenged devaluing the role of Engineer and putting the parties to lose their money on expensive dispute resolution procedures. This research was focused on identifying the situations where Engineer's determination is challenged in Sri Lankan context. The study was based on a documentary survey and finds that most frequently challenged decisions are related to adjustment for cost escalation, delayed instructions and fixing rates for variations. The findings are useful in formulating strategies to minimize such instances.

Keywords: *Construction; Disputes; Engineer's Determination, Sri Lanka.*

*Corresponding Author: e-mail - suranga@uom.lk

IDENTIFICATION OF A TECHNOLOGICAL FRAMEWORK FOR IMPLEMENTING BUILDING INFORMATION MODELLING IN SRI LANKA

Kasun Gunasekara* and Himal Suranga Jayasena
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Building Information Modelling (BIM) is an important component in sustainable procurement strategies. With the rise in popularity, it is gaining the potential to be industry standard for building projects. By taking the digital design data to a new level, BIM promotes better integration and optimum use of resources for the sustainability in all aspects of construction. This is being experienced by more developed countries, which have gained benefits after successfully implementing BIM. Although BIM has not yet been implemented in Sri Lankan building industry, it is likely to be an option for consideration in the near future. As BIM is fully dependant on technology, determining a proper framework is an essential prerequisite. Considering the differences in the building industry among Sri Lanka and other countries, a generic framework will not be practically capable in facilitating such implementation successfully. Under this context, a research is conducted with the broader aim of determining a BIM technological framework for Sri Lanka, a special case where the current technology is minimal and funding ability is low. With preliminary findings from a literature review on the technological prerequisites of adopting BIM, this paper presents logical conclusions developed for technological aspects of implementing BIM for Sri Lankan building industry. The findings shall be a valuable source for all parties who are interested in utilizing BIM technology in the future for the sustainability in building industry of Sri Lanka.

Keywords: *Building Information Modelling; BIM; Construction; Sri Lanka; Sustainability.*

* Corresponding Author: e-mail - kasun1989@gmail.com

IMPACT OF GOVERNMENT POLICIES AND REGULATIONS WHEN ADOPTING ALTERNATIVE PROCUREMENT METHODS

Chamal Wijewardana*, Himal Suranga Jayasena and K.A.T.O. Ranadewa

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

The freedom to choose a procurement method will significantly affect the sustainability of the project delivery process and the operation of the building as well. Even though there are number of different procurement methods subsist in the industry, traditional procurement methods and design and build procurement methods are dominate the Sri Lankan construction industry where some conventional procurement methods have numerous inefficiencies inherently or arising from specific contexts of application. With the development in the construction industry number of projects will towards to achieve the sustainability where difficult to adopt traditional procurement methods. However a general reluctance to adopt alternative procurement methods has previously been observed by many researches. They further have suggested that the reluctance is fuelled by the government policies. Hence this paper synthesizes the preliminary findings, providing a logical picture on the effect of government policies as a barrier to adopt alternative procurement methods and how far the current policies would help to popularize less popular procurement methods.

Keywords: *Alternative Procurement Methods, Barriers, Facilitators, Government Policies, Sri Lanka.*

* Corresponding Author: e-mail - chamalwijewardana@gmail.com

IMPACT OF MAINTENANCE MANAGEMENT PROCEDURES ON ENERGY EFFICIENCY OF CHILLERS

M. R. Siriwardana
Hirdramani Industries (Pvt) Ltd., Sri Lanka

Nayanathara De Silva* and R. A. G. Nawarathna
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

The most important element of the central air conditioning system, the chiller, accounts for about 40% of annual total energy consumption of commercial and industrial buildings. As a result, many approaches have been proposed to increase energy efficiency of chillers with the intention of managing the annual total energy consumption of facilities. Among them, it was revealed that the approach of proper chiller maintenance procedures lead towards the energy efficiency of chillers. Therefore, the research was focused on identifying the impact of maintenance management procedures on energy efficiency of chillers.

The data was collected through a pilot survey and a main survey which were followed by a questionnaire along with observations and interviews with experienced industry practitioners.

It was identified that the maintenance procedures has a great impact towards the energy efficiency of chillers. Perform condenser water quality test, Monitoring refrigerant pressure and temperature, Monitoring water flows, cleaning of condenser bundle and cooling tower cleaning and water treatment were identified as the most significant maintenance activities which assist to meet the standard energy efficiency level of chillers. Eventually, a multiple linear regression model was developed with the intention of deriving relationship between performance deviation of above maintenance activities and energy efficiency drop of chillers.

Keywords: *Chillers; Energy Efficiency; Energy Efficiency Drop; Maintenance Management Procedures; Maintenance Performance Deviation.*

*Corresponding Author: e mail- endds@uom.lk

IMPORTANCE OF OCCUPANTS' EXPECTATIONS FOR ACCEPTANCE OF GREEN BUILDINGS: A LITERATURE REVIEW

B. H. Mallawaarachchi* and M. L. De Silva and R. Rameezdeen
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

The buildings, where people live, work, and protect people from nature's extremes, yet they also affect human health and environment in countless ways. The increasing consensus on climate change has resulted in escalating demands on the public to make better environmental choices in building construction. The term 'green design' has been used fairly consistently over the past decade to emphasize such environmental performance of buildings. Many studies have found that the construction clients are demanding assurance of their buildings' long-term economic and environmental performance and costs. Further, the occupants have been favourably disposed to green buildings from their conventional environments. Moreover, in the early stages of a transition towards sustainability, the priorities placed on environmental issues are subscribed by society as a whole and those implicit in building owner's priorities and expectations. Hence, the modern practice has extended and complemented the conventional building construction process to achieve sustainable or high performance building. Accordingly, key research papers were reviewed in this research paper in order to identify occupants' expectations and its importance for the acceptance of green building. Literature stated that there is more potential to change the existing buildings to be more 'green', as the quality of built environment is a major expectation of building occupants. Further, most of the occupants expect quality indoor environment with properly controlled and maintained temperature, humidity, noise, lighting and thermal comfort parameters within buildings. It is due to the certainty of reaching their expectations specially to obtain comfortable working environment. Hence, it implies that the occupants' expectations are significance for the acceptance of any green building specially in moving from their typical working environments. The reason is that the poor fit between the built environment and the needs and expectations of the occupants may lead to dissatisfaction, health issues and productivity losses.

Keywords: *Building Occupants; Expectations; Green Building; Indoor Environment Quality; Acceptance.*

*Corresponding Author: e-mail - hmallawarachchi@gmail.com

IMPROVING INDOOR AIR QUALITY FROM EFFECTIVE VENTILATION SYSTEMS IN OFFICE BUILDINGS IN SRI LANKA

K. W. D. K. C. Dahanayake* and Chitra Weddikkara
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Indoor air quality (IAQ) becomes a major consideration in indoor environments as it directly affects occupants' health and comfort. Sick building syndrome (SBS) and adverse perception on IAQ had become significant issues of poor IAQ in Sri Lankan context. These IAQ problems arise due to poorly designed, maintained, or operated ventilation systems. Further, different types of ventilation systems such as natural ventilation and mechanical ventilation have different impacts in IAQ. Yet, it is important to identify IAQ issues in order to improve IAQ through effective ventilation systems. Therefore, this research was aiming to identify IAQ issues with the intention of improving IAQ from effective ventilation systems in office buildings in Sri Lanka. A quantitative research approach based on questionnaire survey and observation were used in order to achieve the objectives. A statistical analysis was carried out to obtain findings of the research. The study revealed that occupants in naturally ventilated buildings were healthier compared to occupants in MVAC buildings.

Keywords: *Indoor Air Quality; MVAC, Natural Ventilation; Sick Building Syndrome.*

*Corresponding Author: e-mail - kdahanayake@yahoo.com

INFLUENCE OF CHANGE MANAGEMENT FOR EFFECTIVE OUTSOURCING OF FACILITIES MANAGEMENT SERVICES

Pournima Sridarran* and Nirodha Gayani Fernando
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

The procurement by partial or full outsourcing of Facilities Management services is one of the options available for operation and maintenance of buildings. Since the recent past, this has been observed as a popular trend in this sector. Outsourcing can bring about many changes and conflicts into the organisation. This is due to many reasons such as services being performed in different ways, some services changing in quality and rhythm, the employees being asked to do things differently and the organisational culture also having to adopt the changes. Organisations need to adopt an intelligent approach to manage such changes if they are to maintain the continuity of the operations. As such, the aim of this study is to identify the influence of change management towards the effective outsourcing of Facilities Management services. Multiple case study method was adopted as the research methodology for this purpose. Data were analysed against the three predetermined categories which were; reasons for the outsourcing, the impact of change during outsourcing practices, and incorporating the change management with the outsourcing practices, in order to reach a compromise. Findings of the study reveal that the efficiency of outsourcing the Facilities Management services can be improved and the organisations can reap the maximum benefit out of such outsourcing if the change management is handled in an effective manner.

Keywords: *Change Management; Facilities Management; Outsourcing.*

*Corresponding Author: e-mail - psridarran@gmail.com

IN-HOUSE VERSUS OUTSOURCING FACILITIES MANAGEMENT: A FRAMEWORK FOR VALUE-ADDED SELECTION IN SRI LANKAN COMMERCIAL BUILDINGS

M. H. S. Ahamed*, B. A. K. S. Perera and I. M. C. S. Illankoon
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Facilities Management (FM) in the commercial building industry has been receiving increasing attention recently. FM is a multi-skilled profession which gives resources support for the core business because it concerns both optimizing building performance and ensuring the commercial success of the organization. However, in the Sri Lankan context, most organizations solely focus on the financial aspect while choosing between the outsourcing and in-house FM options, thus excluding other non-financial aspects such as the extent to which the FM route contributes to improving internal business processes and the overall strategic health of the organization. Hence, there is a need to arrive at specific framework for efficient decision making when choosing between the outsourcing and in-house FM approach for the purpose of addressing FM needs. However, the literature so far has failed to develop a framework when choosing the best FM approach for commercial buildings. The present research intends to fill this gap. This study presents the results of an investigation through a literature review into arriving at a holistic perspective on the key variables to be considered in choosing between outsourcing and in-house FM in order to provide value added services and to improve organizational performance. The paper therefore develops a decision support model for selection between outsourcing and in-house FM services through research.

Keywords: *Commercial Buildings; Facilities Management; In-house, Outsource.*

* Corresponding Author: e-mail - sakeeyahamed@gmail.com

INTEGRATED FACILITIES MANAGEMENT PRACTICES IN SRI LANKA: A PRELIMINARY INVESTIGATION

R. P. N. P. Weerasinghe* and Y. G. Sandanayake
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

In this era of globalisation and fierce competition amongst businesses, most companies around the world faces relentless pressure to reduce cost, add value and support business goals for sustainability. Hence, innovative ideas, concepts and methodologies are needed to meet these demands. Integrated facilities management is one such concept, which extended beyond the traditional firm boundaries by enforcing external relationships. Few researchers have identified formation of networks, partnerships, or inter-organisational collaborations among neighbouring built environments as successful mechanisms in optimising the performance of facilities management (FM) functions. Although it is commonly agreed that organisations could benefit from integrated FM, a systematic framework for integration of FM functions has yet to be derived. Therefore, there is a need to investigate existing integrated FM practices and the applicability of integrated FM concept to built environments. The aim of this study is therefore is to review the concept of integrated FM and to investigate the existing integrated FM functions in Sri Lanka. The aforementioned research question was approached through a multiple case study including four cases that have integrated building facilities and FM functions with another organisation/s. Data was collected using observations and semi-structured interviews with facilities managers in the respective organisations. The findings revealed that if the firms are in close proximity, although the core businesses are same or not, there is a high potential of sharing physical facilities and FM functions among the firms. There is also a possibility of integrating FM functions among distantly located facilities when,(i) they are under same ownership, (ii) there is a close relationship between organisations or (iii) they obtain the service from outsourced FM service provider. The findings of this study will be useful in integrating FM practices in Sri Lanka.

Keywords: *Integrated Facilities Management (FM); Shared Facilities; Shared FM Functions.*

*Corresponding Author: e mail- nilminiweerasinghe@ymail.com

OVERCOMING SUSTAINABILITY ISSUES THROUGH FINANCIAL RISK MANAGEMENT IN PRIVATE FINANCE INITIATIVE PROJECTS

U. T. Withanachchi* and Nirodha Gayani Fernando
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

The sustainable procurement is the process in which the sustainable needs are achieved by balancing against the business needs while considering enhancing the values through entire lifecycle of the product, waste reduction and recycling. Among the sustainable procurement approaches, Private Finance Initiative (PFI) is one of them, which is bringing together the public and private sectors to work together in partnerships to best utilize the assets and skills of both sectors with the aim of creating better value for money for taxpayers while initiating the projects with funds of private sector. However, the risk which is in adverse and uncertain by nature leads to sustainability issues in PFI procurement. Project finance (PF) refers to situations where the loan for the project is repaid from the future cash flows of the project. Project finance has been used wide for financing infrastructure and public sector facilities like hospitals, power stations, prisons, etc. Financial risk as the impact on the financial performance of any entity exposed to risk. Therefore, there is a need to minimize the financial risk in PFI projects. Accordingly, the aim of the study was to emphasis on overcoming sustainability issues on project financing through better financial risk management for PFI projects in construction sector. Comprehensive literature review was conducted to identify the tools and techniques. The study was developed to provide step by step details in identifying and analyzing the key risks and mitigation procedures in sustainable way at particular project phase. Then the gaps were identified and the opinions to improve the sustainability were identified.

Keywords: *Construction Industry; Private Finance Initiative; Risk Management; Sustainable Procurements.*

* Corresponding Author: e-mail - udtharangaw@gmail.com

PLANT AND EQUIPMENT MANAGEMENT TO MINIMIZE DELAYS IN ROAD CONSTRUCTION PROJECTS

Sri Nuwan Randunupura* and Chandanie Hadiwattege
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Construction is the ultimate objective of a design, and the transformation of a design by construction into a useful structure which is accomplished through proper management of human, material, machineries and equipment resources. A project manager must insure that these inputs are effectively coordinated to achieve an efficient construction process. "Delay" in construction is a project slipping over the planned schedule and is considered as a common problem in construction projects. Plant and Equipment (P&E) management is a complex procedure in a construction project. Machines are to be selected, arrived on site, are used and, when a project is completed, removed and returned to the company's plant depot or the hire company. Within this cycle various decisions and assessments are required to be made. These are related to above challenges and delays due such could be affected directly or indirectly by poor P&E management. Hence, introduction of proper construction P&E management criteria helps in minimizing the confusion created due to the above problems and further to cut down monetary losses.

Therefore, this research aims to study the effects of improper P&E management on construction delays and to identify proper practices on P&E management to minimize delays. The paper discusses the theoretical background of the issue based on the findings of the comprehensive literature review done through refereeing to the published material. Research will be followed by a questionnaire survey to explore the situation within the Sri Lankan road construction projects as the field study. The data will be analyzed statistically in order to make conclusions and recommendations.

Keywords: *Construction Projects; Delays; Management; Plant and Equipment.*

* Corresponding Author: e-mail - srinuwanr@gmail.com

PRIMARY STUDY OF THE IMPACT OF IN-SITU AND FACTORY PRODUCTS IN SRI LANKAN CONSTRUCTION INDUSTRY

Manoj Thudugala* and L. D. Indunil P. Seneviratne
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

In an environment of aggravating labour shortage, it is inevitable for the construction industry to face number of difficulties. Therefore it is essential to explore ways and means to develop less labour intensive products, and identify whether these provide real solutions in reducing time and cost with enhanced quality. Further, it is obvious that the current construction industry is in a dilemma with lack of knowledge on behaviour of those aspects. Contactors hesitate to use factory products as these products are expensive, even these would lead to time savings and reduction of labour requirement and also towards sustainability in construction through many aspects. Therefore the need for a comparison between in-situ and factory made products on time, cost and quality is a need of time.

This ongoing research mainly focuses on the usage of factory made and in-situ products based on the respective pros and cons. This was done by initiating a survey among various expertises in the industry. Further, prioritizing the most labour intensive products was very essential to identify what trade areas are the main concerns. Therefore the overall time, cost and quality aspects of in-situ products can be compared with correspondent factory products and identify the challenges on the contractors for using the effective alternatives.

This paper contains the preliminary findings of a literature review conducted on the use of in-situ and factory based construction components both locally and globally.

Keywords: *Cost; Factory Made; In-Situ; Labour; Quality Time.*

*Corresponding Author: e-mail - manojtudugala@gmail.com

PSYCHOLOGICAL CONTRACT WITH CONSTRUCTION LABOUR FOR SUSTAINABILITY IN CONSTRUCTION

L. L. Ekanayake* and S. A. V. N. Chandradasa
Department of Civil Engineering, University of Moratuwa, Sri Lanka

ABSTRACT

The Construction Industry in general and its workforce in particular are the essential partners for rapid economic progress of a country. In the process of marching towards a developed nation, Sri Lankan construction industry has to play its due role. However, industry faces tremendous challenges to sustain the existing workforce and to attract additional skilled and unskilled workforce to the industry to deliver its promises. Effective Human Resource Management (HRM) practices to increase industry productivity standards and retention of construction labour through appropriate contracts with them were highlighted in this regard. Employment 'contract' is defined as the bond between the employer and employee for a given task. The emphasis of 'psychological contract' is to bring the importance of mutual trust and understanding between two parties where implied terms are vital than written contract.

This paper introduces a framework for Psychological contract with labour based on literature review and pilot interviews. Psychological contract model for construction labour contracts was proposed by emphasizing the 'remuneration and welfare', 'dignity' and 'motivation and performance of labour' as three main pillars for building the proposed model. Preliminary findings suggest adopting innovative HRM practices embedded with psychological contract for construction industry to ensure its sustainability.

Keywords: *Construction HR and Psychological Contract; Construction Industry Sustainability; Construction Labour Productivity and Motivation; Construction Labour Shortage.*

* Corresponding Author: email - lesly@civil.mrt.ac.lk

RELATIONALLY INTEGRATED VALUE NETWORKS FOR SUSTAINABLE PROCUREMENT

Sachithra Weerapperuma* and Nayanathara De Silva
Department of Building Economics, University of Moratuwa, Sri Lanka

Mohan Kumaraswamy
Department of Civil Engineering, University of Hong Kong, Hong Kong SAR

Malik Ranasinghe
Department of Civil Engineering, University of Moratuwa, Sri Lanka

ABSTRACT

Relationally integrated value networks (RIVANS) aim to boost collaboration in built infrastructure supply chains, thereby improving both efficiencies and value creation. However, in widely practiced traditional procurement modes, transactional forces are still complex and short-sighted, resulting in weak collaborative supply chain networks, while potentially beneficial relational forces remain untapped and/or fragmented, lacking well-defined common goals among stakeholders. RIVANS have been proposed to provide a holistic conceptual framework for relational integration towards the concept to all stakeholders in the built asset lifecycle, by engaging them in cross linked value networks. The ultimate goal is for sustainable procurement through RIVANS, by developing collaborating practices and overall value focus across the entire network and through the whole built asset life cycle. A questionnaire survey was carried out to elicit relevant opinions from industry professionals. The survey led to identifying eight potential synergies/better values by linking supply chains in Infrastructure Project Management (IPM) with Infrastructure Asset Management (IAM). Functional and relational integration were identified as an appropriate mechanism to achieving value through integration. The degree of importance of eleven common goals was identified in achieving 'better value'. The key stakeholders of D&C and O&M value networks were also identified.

Keywords: *Asset Management; Procurement; Project Management; Relationally Integrated Value Networks; Supply Chain Management.*

*Corresponding Author: e-mail - sachithraweerapperuma@gmail.com

ROLE OF ACADEMIC RESEARCH IN SUSTAINABLE CONSTRUCTION PRACTICE

Chandanie Hadiwattege* and Nirodha Fernando
Department of Building Economics, University of Moratuwa, Sri Lanka

Sepani Senaratne
School of Computing, Engineering and Mathematics, University of Western Sydney, Australia

ABSTRACT

Higher education is becoming a major driver of economic competitiveness in an increasingly knowledge-driven global economy. A university is a scholarly organism committed to inquiry, investigation and discovery at all levels with an embedded symbiotic relationship between teaching, research and practice. In addition to the primary duty of delivering good quality teaching, universities have another key responsibility: that is to add new knowledge to the wider society through research. Furthermore, the outcome of the research should serve educational needs and the development of the region and its economy.

The construction industry being one of the important industries in the economy, it's stakeholders need to adapt complex and changing conditions continuously to sustain and proliferate through innovation. Research and Development acts as a valuable input for the construction organisations innovation in many ways. Therefore, it is important to move beyond the traditional practices in the construction industry to adopt sustainable construction practices arising from research and development activities. This paper argues that the research conducted by university academics in the built environment discipline should be directed towards this industry need of sustainable construction practices.

Within this context, the aim of the study is to address the role of academic research in sustainable construction practice. A comprehensive literature survey was conducted through referring to refereed published material in the related area. Study revealed that academic research can play a major role in developing sustainable practices in construction. The paper reports only the findings of the literature review. Field study will be done using case study approach to explore the actual situation in Sri Lankan context.

Keywords: *Academic Research; Construction Industry; Sustainable Construction Practices.*

*Corresponding Author: email - chandanieqs@yahoo.com

SEARCH FOR KEY PERFORMANCE INDICATORS (KPIS) FOR TARGET COST CONTRACTS IN HONG KONG

Daniel W. M. Chan*

Department of Building and Real Estate, The Hong Kong Polytechnic University, Hong Kong

Joseph H. L. Chan

Department of Civil Engineering, The University of Hong Kong, Hong Kong

ABSTRACT

In view of the adversarial working relationships inherent with the traditional procurement method, Target Cost Contracts (TCC) and Guaranteed Maximum Price (GMP) contracts (being a variant of TCC), which align the individual objectives of various contracting parties together, would be appropriate integrated procurement models to cultivate more collaborative working atmosphere and partnering spirit within the construction industry. Different countries have already applied both TCC and GMP (TCC/GMP) schemes for several years. However, there exists a lack of published literature about the performance measurement of TCC/GMP projects worldwide, particularly in the Hong Kong context. In order to fill up this knowledge gap, this paper aims to identify those key performance indicators (KPIs) for TCC/GMP contracts in the construction industry of Hong Kong. Based on a series of various KPIs sought from a comprehensive desktop review, a two-round Delphi survey was launched with 14 industrial practitioners with direct hands-on experience in TCC/GMP construction projects in Hong Kong. A total of seven KPIs were identified in the survey. It was found that time, cost and quality are perceived as the typical KPIs for these kinds of projects. Moreover, the research findings reflected that relationship-based elements are also discerned as significant performance indicators such as mutual trust between project partners and contractor's involvement in project design, which play a vital role in project performance associated with TCC/GMP schemes as well. The identification of those KPIs has enhanced the understanding of project team members in implementing a successful TCC/GMP project.

Keywords: *Delphi Survey Method; Guaranteed Maximum Price Contracts; Hong Kong; Performance Measurement; Target Cost Contracts.*

* Corresponding Author: e-mail - daniel.w.m.chan@polyu.edu.hk

SPECIAL FEATURES, EXPERIENCES AND NEW TRENDS IN ARBITRATION IN THE CONSTRUCTION INDUSTRY OF SRI LANKA

Mahesh Abeynayake* and Chitra Weddikkara
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

In Sri Lanka, Alternative Dispute Resolution (ADR) methods such as negotiation, conciliation, mediation, adjudication and arbitration can be identified as preferable alternatives for replacing traditional litigation as they would be more effective in time and cost. Arbitration is a voluntary procedure available as an ADR method to litigation. The main feature of arbitration is that it is consensual in nature and private in character. Arbitration Act of Sri Lanka No 11 of 1995 stated that arbitration principles and contents are based on UNCITRAL Model Law. At present, many parties to construction disputes have no interest in pursuing for arbitration. Therefore, professionals should take collective measures to increase the effectiveness of arbitration. With the increase in construction activity after 30 years of civil war the construction industry of Sri Lanka needs a fast and cost effective dispute resolution method. The aim of this research is to critically evaluate the arbitration method, its experiences and new trends as an ADR method in the construction industry of Sri Lanka, and suggest improvements to its practice in order to make arbitration procedure more effective. The research is to develop arbitration as an effective and efficient ADR method in the Sri Lankan construction industry. Literature review for the research was carried out together with the survey. The questionnaire survey was used among construction industry professionals. Accordingly, data collection was selected only from experienced professionals in the industry. This research is limited to the arbitration in the construction industry of Sri Lanka.

The findings of the research indicate that the professionals who are involved in the construction industry have low level of satisfaction on the current practice of arbitration. However, they believe that arbitration is an effective mechanism for dispute resolution in Sri Lankan construction industry. The results of this study enable researchers to gain an understanding of the current arbitration practice and recognise significance of advantages, drawbacks and suggestions for the development of arbitration in the construction industry of Sri Lanka.

Keywords: *ADR Methods; Arbitration; Construction Industry; Dispute Resolution.*

* Corresponding Author: e-mail - abey92@hotmail.com

STAKEHOLDERS' PREFERENCE TOWARDS THE USE OF CONFLICT MANAGEMENT STYLES IN DUAL CONCERN THEORY IN POST CONTRACT STAGE

M. A. C. L. Gunarathna* and Nirodha Gayani Fernando
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

The tendency of having conflicts is extremely high in construction industry due to the complexity in relations, lengthy process and multidisciplinary involvement. It can be seen that conflicts in post contract stage have more tendency to increase due to number of reasons. Even though the industry uses conflict management styles, still there is no sign of decreasing conflicts which are subsequently converting into disputes. Therefore, the requirement of conflict management should receive a prior consideration. Construction professionals commonly use dual concern theory as their conflict management style. However, they are incapable of using this management style effectively according to the conflict situation so that the amount of conflicts is rising. This creates a current issue of minimizing conflicts by effective management because it directly affects the project success. Since conflicts disturb the proper coordination and corporation of human resource and cause project delays, effective conflict management in construction projects leads the project towards the sustainable construction practice by creating a proper coordination between all relevant parties and eliminate unnecessary project delays caused by conflict environment. Accordingly, the aim of this study is to identify the stakeholder preference towards the conflict management styles in Dual Concern Theory in post contract stage. A comprehensive literature review and an interview from selected case studies were conducted to collect data. The findings of this study prove that having a proper conflict management can achieve sustainable construction practices such as using human resource efficiently, willingness to work and effective time management.

Keywords: *Conflict; Construction Industry; Conflict Management; Dual Concern Theory; Post Contract Period.*

*Corresponding Author: e-mail - lakshika.gunarathna@yahoo.com

STRENGTHENING THE SAFETY CULTURE FOR ORGANIZATIONAL SUSTAINABILITY

N. H. C. Manjula* and Nayanthara De Silva
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

The term 'sustainable development' can be defined as satisfying the needs of the current generation, without jeopardizing the future generation's ability to meet their needs. In terms of organizations, a Sustainable organization concerns the original momentum of the business continuity of the organization. Occupational Safety and Health (OSH) in general plays a key role in supporting business activities and delivering economic prosperity for the organization. Thus, OSH becomes a necessity for organizational sustainability. Organisational culture is a concept often used to describe shared corporate values that affect and influence members' attitudes and behaviours. Safety culture is a sub-facet of organizational culture, which is thought to affect members' attitudes and behaviour in relation to an organisation's ongoing safety and health performance. This paper aims to investigate the factors that influence safety culture positively in order to support the sustainability of the organization. A literature synthesis on organizational sustainability, occupational safety and health, safety culture, definitions of safety culture, components of safety culture and way to strengthen a safety culture are presented. The research findings highlighted that a safety culture mainly comprises of three components, namely, attitudes-both individual and organizational, work environment of and OSH systems occupied. Further few factors that influence safety culture positively were distinguished as management commitment to OSH, employee involvement and empowerment, proper OSH systems and feedback mechanisms, and continuous monitoring of OSH systems.

Keywords: *Occupational Safety and Health, Safety Culture, Sustainable Organizations.*

*Corresponding Author: e-mail - chathuri9m@gmail.com

TECHNO-ECONOMIC FEASIBILITY OF INTEGRATION OF GREEN TECHNOLOGIES FOR AFFORDABLE HOUSING

M. V. Madurwar* and R. V. Ralegaonkar
Department of Civil Engineering, VNIT, India and Department of Civil Engineering, VNIT, India

S. A. Mandavgane
Department of Chemical Engineering, VNIT, India

S. P. Raut
Department of Civil Engineering, YCCE, India and Department of Civil Engineering, VNIT, India

ABSTRACT

The conventional construction technology along with spiralling cost of traditional building materials makes the housing unaffordable or a distant dream for an average income salaried person. The aim of a paper is to design an affordable green building model for an Economically Weaker Section (EWS) housing scheme to compare energy, carbon footprint and water performance. In this, a single dwelling unit plan is worked out for a EWS housing scheme using the identified green materials & techniques and compared with conventional material & techniques of construction. The study reveals that the integrated sustainable technologies like application of energy efficient building construction materials, implementation of water management and energy management techniques make the housing schemes energy efficient and cost effective to the economically weaker section of urban area.

Keywords: *Affordable Housing; Economically Weaker Section; Energy Efficient Building; Sustainable Technologies.*

* Corresponding Author: e-mail - mangeshmadurwar@gmail.com

THE NEED FOR AN INTEGRATED COST MODELLING FRAMEWORK FOR BUILDING INFORMATION MODELLING

Ramadha De Silva* and Himal Suranga Jayasena
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Building Information Modelling (BIM), a revolutionary concept in the construction industry, produces an object-oriented, intelligent and parametric digital representation of the construction facility, which requires a collaborative participation of members of the design team members. These emphasize that BIM has characteristics of sustainable procurement strategies. Open BIM standards developed by building SMART International, are the most popular data standards for BIM to share digital construction information within the design team and beyond throughout the life cycle of the project. Other proprietary BIM standards are also extensively used, but they often have limitations on sharing information across all stakeholders. Even though BIM conceptually is an integrated approach for all project team members, not all functions are performed within the common platform. Project participants use their domain specific tools often with proprietary standards, and share the results translated to common standards. BIM enables a live information model with which all project participants can actively interact. This enables minimizing of errors and early clash detection, paving the way to sustainable project delivery methods. However, Quantity Surveying functions within a BIM based project delivery was found to be least interactive. This has hindered the real benefits receivable from a BIM implementation. Since, a cost model will provide critical information required for decision making at various stages, an up-to-date cost model is critical for a BIM based project delivery. While a variety of software tools is used for this purpose, a standardized method is not found to share cost information effectively with BIM. This study aims to develop a suitable framework for cost modelling for a BIM implementation in order to help develop BIM standards for cost modelling. This paper contains the preliminary findings of an ongoing research.

Keywords: *Building Information Modelling; Cost Modelling; Open BIM Standard; Quantity Surveying.*

* Corresponding Author: e-mail - ramadha.desilva@gmail.com

THE RESHUFFLE OF CONTRACTUAL LIABILITIES BY IMPLEMENTING INTEGRATED PROJECT DELIVERY (IPD) IN BUILDING INFORMATION MODELLING (BIM) BASED CONSTRUCTION

Ishara Kasun Madusanka* and Himal Suranga Jayasena
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

"Sustainability by building smarter", the vision of building SMART international clearly conveys what Building Information Modelling (BIM) was developed for. BIM has now been accepted as a primary tool for sustainable project procurement. Building information modelling (BIM) is the latest innovation of construction industry and it is increasingly becoming the design standard for architectural and construction engineering. Effective adoption of the BIM requires a change in the traditional work practices, where it needed a greater collaboration and communication among project participants and efficient flow of information. Conventional procurement methods are less efficient in delivering these requirements. The Integrated Project Delivery (IPD) approach is widely recognized as the most suitable project delivery approach to receive the full benefit of BIM adoption for construction project procurement. Basic concept of IPD is the collaboration among the owner, architect, and contractor to create the core team. The team focuses on trust, transparency, shared risk and reward, value-added decision making, and technology to complete a project as efficiently and effectively. Collaborative approaches to project procurement are very rare in Sri Lanka. A concept like IPD is totally a new paradigm for the local industry. Given the context that BIM is likely to become the standard in future and the widening global competition will force the local industry to adopt methods like IPD. This research is conducted to identify the reshuffle of contractual liabilities in IPD from those in traditional delivery method, where the findings will help the industry to get prepared to face future challenges.

Keywords: *Building Information Modelling, BIM, Contractual Liability, Integrated Project Delivery*

* Corresponding Author: e-mail - ishara.kasun89@gmail.com

THE RESHUFFLE OF RISKS FROM IMPLEMENTING BIM BASED INTEGRATED PROJECT DELIVERY IN SRI LANKAN CONSTRUCTION INDUSTRY

Anuradha Abeyratne* and Himal Suranga Jayasena
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

The shift from traditional procurement systems, towards more collaborative procurement systems which are backed-up with information and communication technology (ICT), is becoming the new trend in the present day construction industry around the world. Integrated Project Delivery (IPD) and Building Information Modelling (BIM) are the two most emerging and widely used systems to achieve this shift. These concepts are likely to be the new industry standard in the near future due to their collaborative nature, ability to implement sustainable procurement strategies, risk and reward sharing basis and high efficiency of construction by promoting dry construction. Yet, the Sri Lankan construction industry is still following the traditional rigid and highly separated procurement systems with traditional 2D computer aided drafting (CAD). Therefore adopting and continuing BIM and IPD will generate many issues and risks since the industry is used to the absolute opposite of the underlying principles of both BIM and IPD. Under this context, a research is conducted with a broader aim of identifying the potential reshuffle of risks, which a construction project in Sri Lanka would be subjected, if it is delivered through BIM based IPD. This paper contains the preliminary findings of a literature review conducted on the current risks the industry faces and on identifying the requisites of BIM and IPD.

Keywords: *Building Information Modelling (BIM); Integrated Project Delivery (IPD); Risks; Sri Lanka; Sustainability.*

* Corresponding Author: e-mail - aabeyratne88@gmail.com

USE OF RECYCLE PAPER MILL RESIDUE AND FLY ASH IN PRODUCTION OF WASTE-CREATE BRICKS

S. P. Raut* and R. V. Ralegaonkar
Department of Civil Engineering, YCCE, India and Department of Civil Engineering, VNIT, India

S. A. Mandavgane
Department of Chemical Engineering, VNIT, India

Mangesh Madurwar
Department of Civil Engineering, VNIT, India

ABSTRACT

Accumulation of unmanaged industrial solid waste, especially in developing countries has resulted in an increased environmental concern. Resource recovery and utilization of industrial by-product materials for making construction material has gained significant attention across the world. In this research study, recycle paper mill residue (RPMR) and fly ash (FA) are utilized to improve the properties of bricks. This research study evaluated the feasibility of utilizing RPMR and FA for making construction bricks. A homogeneous mixture of RPMR-FA-cement was prepared with fixed content of RPMR (50% by weight) and varying amount of FA (30-50% by weight) and cement (0-20% by weight). The waste-create bricks were developed from the homogeneous mixture of RPMR-FA-cement and tested in accordance with the IS codes. Characterization of RPMR and FA was performed. The SEM monographs show that RPMR has a porous and fibrous structure. The TG-DTA characterization demonstrated that RPMR can withstand temperatures up to 280 oC. The results indicate that RPMR- bricks prepared from RPMR-FA-cement combination are light weight and meet compressive strength requirements of IS 1077-1992. This novel construction material serves objectives of resource recovery through prudent solid waste management.

Keywords: *Compressive Strength; Fly Ash; Recycle Paper Mill Residue; Waste-Create Brick.*

* Corresponding Author: e-mail - sprce22@gmail.com

USE OF RECYCLED AGGREGATES IN STRUCTURAL CONCRETE

E. S. Y. Premasiri, A. B. Y. Kariapper, A. M. G. G. M. B. Abeysinghe and S. Karunaratne*

Department of Earth Resources Engineering, University of Moratuwa, Sri Lanka

ABSTRACT

Properties of the recycled aggregates and the suitability of the same in structural concrete were studied and compared them with natural aggregates. The results showed that the particle size distribution of recycled aggregates is compatible with those of natural aggregates. The recycled aggregates had abrasive and impact values of 48.7% and 27.10%, respectively while those of the natural aggregates were 29.5% and 11.45, respectively. Bulk density of recycled aggregates was 1065 kg/m3 with compared to 1296 kg/m3 of Natural aggregates and the water absorption was 2.82% with compared to 1.22 of Natural aggregates. The mix design proposed for concrete was grade 30. Properties of concrete made under three mixing scenarios of natural aggregate to recycle aggregate proportions such as 50% -50%, 25%-75%, and 0%-100% were compared with those of 100% natural aggregates. With increasing percentage of recycled aggregate content, compressive strength, flexural strength, tensile splitting strength and workability were significantly decreased. According to the results, grade 30 concrete properties could be achieved with mix proportions of 50% natural aggregate and 50% recycled aggregate, without significantly affecting the concrete properties, indicating a 50% saving of natural aggregates thus reducing environmental impacts and enhancing sustainability.

Keywords: *Compressive Strength; Flexural Strength; Mix Design; Tensile Splitting Strength; Workability.*

* Corresponding Author: e-mail - shiromi27@yahoo.co.uk

USE OF SUSTAINABLE MATERIALS IN CONSTRUCTION INDUSTRY CONTRACTOR'S PERSPECTIVE

I. M. C. S. Illankoon* and K. G. A. S. Waidyasekara
Department of Building Economics, University of Moratuwa, Sri Lanka

W. P. S. Karunadasa
State Engineering Corporation, Sri Lanka

ABSTRACT

Buildings are the largest energy consumers and greenhouse gas emitters, both in the developed and developing countries. Therefore, it is a dire need in the present status quo to shift to sustainable buildings. Sustainable buildings can be identified as a spectrum of buildings, designed and constructed using methods and materials that are resource efficient and that will not compromise the health of the environment, wellbeing of the building occupants, construction workers, general public or up and coming future generations. In the process of construction of sustainable buildings, while striking a balance between the triple bottom line, environmental, social and economic sustainability, construction material is given a higher priority. Therefore, this research reflexes the use of sustainable building materials in the construction industry.

In the research process, initially a comprehensive literature synthesis was carried out to get an insight on the concept of sustainability and sustainability construction. This was then followed by a questionnaire survey among the M1 and M2 contractors of Sri Lanka. Through the study it was evident that there is perfect knowledge available on the concept of sustainability even though only 48% of the contractors have used sustainable materials in construction. It is necessary to comment that sustainability has now become mandatory in order to tackle many environmental problems. Thus, the usage of sustainable materials in construction is at the verge of being a mandatory requirement in construction. Therefore, this research provides a firm basis to use sustainable materials in construction industry in the perspective of construction contractors.

Keywords: *Construction Industry, Contractor, Sustainability; Sustainable Material.*

*Corresponding Author: e-mail - cillankoon@gmail.com

UTILITY FACTORS AFFECTING FOR SELECTING DELAY ANALYSIS TECHNIQUE

H. M. C. K. Sudeha*, B. A. K. S. Perera and I. M. C. S. Illankoon
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Delays in the completion of scheduled activities as per the work plan will invariably lead to delays in construction. Such delays play havoc in the construction industry especially in a sustainable environment leading to many issues and disputes which in many cases retard the progress of the project. Therefore, minimizing delays is one of the most important factors in sustainable construction. Due to its criticality, a wide range of Delay Analysis Techniques (DAT) has been developed by various analysts over the years to address the issue. Further, with the emergence of new scenarios in sustainable construction with the passage of time, analysts have identified the inherent properties of each of these methodologies. These inherent properties or factors in turn become indicators for measuring the suitability and accuracy of DAT in a given context where they can be grouped into filter and utility factors. However, in the Sri Lankan construction industry, the resolving and managing of construction delays remain at an elementary stage with most analysts opting for an ad-hoc selection rather than being governed by considerations of suitability. This paper contains the findings of a literature review and interviews with experts which compare DAT and factors affecting the selection of DAT. The methodology adopted in undertaking this research is a case study and document reviews. The findings of the study will direct analysts to select the most suitable DAT and to reduce the error margin in delay analysis while aiding the increase in accuracy of delay analysis.

Keywords: *Construction Delays, Delay Analysis Techniques (DAT), Utility Factors*

*Corresponding Author: e-mail - best.of.sudeha@gmail.com

VIABILITY OF PRIVATE SECTOR INVOLVEMENT IN INFRASTRUCTURE PROJECT DEVELOPMENT IN DEVELOPING COUNTRY

Samanthi Manoja Tanabe*
Trillium Residencies, Elvitigala Mawatha, Sri Lanka

Malik Ranasinghe
Department of Civil Engineering, University of Moratuwa, Sri Lanka

ABSTRACT

Since public infrastructures underpin economic and social development, infrastructure project development is essential for the sustainable growth of a country. In many developing countries, large scale infrastructure projects are undertaken through conventional public procurement, using bilateral and/or multilateral funding. On the other hand, the financial capacity and practical project management know-how of the private sector is an attractive option for the government for the sustainable construction of new infrastructures from the macro aspect. For example an infrastructure development financed by the private sector is off-balance sheet, enabling the government to invest more public funds for social projects.

The more popular index used for evaluating the economic feasibility is the Economic Internal Rate of Return (EIRR). The calculation of the EIRR does not capture the feasibility or viability of a project when the private sector is involved in its development because the realistic financial and other risks are not sufficiently assessed and incorporated into the analysis. This paper aims to present a framework to assess the viability of public infrastructure projects reflecting the various risks involved in a project by quantifying and incorporating them to the cash flows and the financial analysis.

Keywords: *Private Sector Involvement; Risk Analysis; Viability.*

* Corresponding Author: e-mail - itanabe1@sltnet.lk

ACKNOWLEDGEMENTS

The Organising Committee would like to express its sincere appreciation to the following individuals and organisations who have contributed to the success of the symposium:

Chief Guest
All Distinguished Guests
All Distinguished Speakers
Keynote Speaker

All the Government and other Institutions including Institute of Engineers, Sri Lanka (IESL), Institute of Quantity Surveyors Sri Lanka (IQSSL), Chamber of Construction Industry (CCI), Organisation for Professional Associations of Sri Lanka (OPA), Federation of Chambers of Commerce and Industry of Sri Lanka (FCCISL) and Board of Investment (BOI)

Scientific Committee Members
Symposium Session Chairs
Session Coordinators
Symposium Secretariat

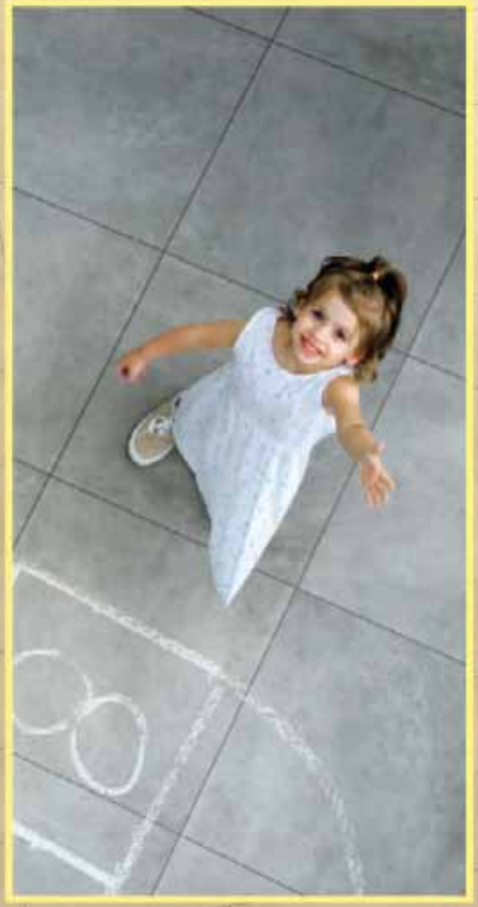
Cinnamon Lake Side Hotel

Printers – Senevi Creation

Gold Sponsor – Sierra Cables Plc.
Silver Sponsors –Siemens Ltd., Ranjanas Ceremics (Pvt.) Ltd., Abans Group of Companies, True Value Products (Pvt.) Ltd.
Bronze Sponsors – GTB Colombo Ltd., Lafarge Cement Ltd.
Official Banker – Hatton National Bank Plc.
Print Media Sponsor – Associated Newspapers of Ceylon Ltd.
Principle Sponsor, Investor Forum – Kaleni Cables Plc.
And All Other Sponsors

AND All those who have helped in one way or another

SPONSORS, PARTNERS & ADVERTISERS



Ranjanas CERAMIC
(PVT) LTD.

Inspiring materials for outstanding appearance

Tile • Granite • Sanitaryware • Faucet • Tile Adhesive

RANJANAS CERAMIC (PVT) LTD.

Head Office & Showroom

307, George R. De Silva Mawatha, Colombo 13.
Tel : (011) 2543255, 5850302 Fax : (011) 2381386
Email : info@ranjanasceramic.lk Web : www.ranjanasceramic.lk

Project Hotline : 011 5850302 Email : projects@ranjanasceramic.lk

BRANCH : 128A, Nawala Road, Nugegoda. Tel : 011-2817474, 011-2817475
Email : nawala@ranajanasceramic.lk

Bringing International Trends to Sri Lanka

NIRO GRANITE MALAYSIA · ORIN MALAYSIA · PORCELANOSA SPAIN · GRANITO INDONESIA · UN INDONESIA · RAK U.A.E. · KLUDI RAK · INDONESIA · MYK LATICRETE · VEMY CHINA · BISAZZA MOSAICO ITALY

Ceylon Institute of Builders (CIOB)

www.ciob.lk

CIOB, the professional body for builders in Sri Lanka, is a strong network Engineers, Architects, Surveyors and similar allied professions who work to inspire, encourage, educate and train students, builders and professionals in the country. The institute welcomes young entrants and mature professionals with or without a background in construction to achieve professional level careers in the industry. They are provided with a well structured development that eventually lead to gaining corporate membership of the Institute.

CIOB works with local with institutes, professional bodies and Government ministries to develop business opportunities and upgrade the Construction industry, expanding its horizons in contributing to the economy. It also provides feedback to the government on their policies affecting the industry while working with the Government to provide appropriate solutions to the problems affecting the industry

Taking the Sri Lankan construction industry to the world, CIOB collaborates with international partner organizations. Acting as the facilitator for national events, delegations as well as organizer of locally held international events, CIOB endeavors to uplift the standards of the Sri Lanka Construction Industry.

www.cibworld.nl

International Council for Research and Innovation in Building and Construction (CIB)

International Council for Research and Innovation in Building and Construction, also known as CIB, acts as a global network for international corporations and information exchange in building and construction research and innovation.

CIB collaborates with organizations around the world supporting the development of the industry, while facilitating international knowledge transfer on topics of interest. It covers the technical, environmental, organizational and other aspects of the built research results, as well as the as the implementation and actual application of the results.

Established in 1953, CIB now has over 5000 experts around the world. Approximately 500 of its individual members and member organizations hold a research, university, industry or government background and active in all aspects of research and innovation.

www.becon.mrt.ac.lk

BEMRU, Department of Building Economics, University of Moratuwa

Building Economics and Management Research Unit (BEMRU), the research arm of the Department of Building Economics (DoBE) at the University of Moratuwa, Sri Lanka, specializes in research in Building Economics and Management in the country as well as internationally.

Established in 1990 under the headship of Professor Chitra Weddikkara, the unit's specialization has strengthened through collaboration with other organizations and institutes in the industry. BEMRU continues to develop and maintain close links with leading research institutes from around the world.

www.iisbe.org

International Initiative for a Sustainable Built Environment (iiSBE)

iiSBE is an international non-profit organization whose overall aim is to actively facilitate and promote the adoption of policies, methods and tools to accelerate the movement towards a global sustainable built environment. iiSBE has an international Board of Directors from almost every continent and has its Secretariat located in Ottawa, Canada.

www.unep.org

United Nations Environment Programme – Sustainable Buildings and Climate Initiative UNEP-SBCI

UNEP-SBCI is a partnership of major public and private sector stakeholders in the building sector, working to promote sustainable policies and practices worldwide.

www.fidic.org

International Federation of Consulting Engineers (FIDIC)

Founded in 1913, FIDIC is charged with promoting and implementing the consulting engineering industry's strategic goals on behalf of its Member Associations, and to disseminate information and resources of interest to its members. Today, FIDIC membership covers 94 countries of the world.

ISBN: ISBN 978-955-4516-04-5