

Centre for Smart Modern Construction

AUBEA 2022

The 45th Australasian Universities Building Education Association Conference

GLOBAL CHALLENGES IN A DISRUPTED WORLD: Smart, Sustainable and Resilient Approaches in the Built Environment

Book of Abstracts

Editors Srinath Perera and Mary Hardie





Centre for Smart Modern Construction

AUBEA 2022

The 45th Australasian Universities Building Education Association Conference

GLOBAL CHALLENGES IN A DISRUPTED WORLD: Smart, Sustainable and Resilient Approaches in the Built Environment

Book of Abstracts

Editors Srinath Perera and Mary Hardie

23 - 25 November 2022 westernsydney.edu.au



Copyright

© Copyright for this Book of Abstracts is vested in Western Sydney University on behalf of AUBEA.

No reproduction, copy or transmission may be made without written permission from the Editors.

Book of Abstracts of the 45th AUBEA Conference 2022

ISBN: 978-1-74108-550-1 DOI: 10.26183/4h5q-h548

Published by Western Sydney University, Locked Bag 1797, Penrith, New South Wales 2751, Australia

Edited by Srinath Perera and Mary Hardie, Centre for Smart Modern Construction (c4SMC), School of Engineering, Design, and Built Environment, Western Sydney University, Australia.

iii

Sponsors

Host University

WESTERN SYDNEY UNIVERSITY Centre for Smart Modern Construction

Gold Sponsor



www.abcb.gov.au

Australian

Bronze Sponsors







Supporters







Table of Contents

AUBEA 2022 Organising Committee	vi
AUBEA 2022 Scientific Committee	vii
List of Reviewers	viii
Welcome Message from the Conference Chair	X
Welcome Message from the President of AUBEA	xi
Message from the Program Committee Chair	xii
Keynote Speakers	xiii
Program Overview	XV
List of Abstracts	xix
Abstracts	1 - 108

AUBEA 2022 Organising Committee

Conference Chair Professor Mike Kagioglou

Conference Co-chairs

Professor Srinath Perera Professor Vivian Tam Associate Professor Mary Hardie Associate Professor Swapan Saha

AUBEA 2022 Program Committee

Chair

Professor Srinath Perera

Theme Leaders

Construction Project Management: Dr Ali Al-Ashwal Digitalisation of Construction: Dr Wei Zhou Industrialisation of Construction: Dr Md Kamrul Hassan Sustainability in Built Environment: Associate Professor Sepani Senaratne Resilience in Built Environment: Dr Robert Osei-Kyei Health and Safety in Construction: Dr Sameera Wijesiri Pathirana Education in Built Environment: Dr Brendan Kirkland CIB Doctoral School - AUBEA 2022: Associate Professor Yingbin Feng

Secretary

Thilini Weerasuriya

Conference Proceedings Subcommittee

Registrations and Logistics Subcommittee

Associate Professor Yingbin Feng Associate Professor Xiaohua (Sean) Jin Associate Professor Sepani Senaratne Dr Ali Al-Ashwal Dr Md Kamrul Hassan Dr Brendan Kirkland Dr Robert Osei-Kyei Dr Sameera Wijesiri Pathirana Dr Krisanthi Seneviratne Dr Wei Zhou Thilini Weerasuriya Mohammed Hummadi Samudaya Nanayakkara Isaac Akomea-Frimpong Klaudia Jaskula De-Graft Joe Opoku Prasad Perera Augustine Senanu Komla Kukah Kola Olayiwola

Associate Professor Payam Rahnamayiezekavat Dr Matt Stevens Dr Anthony Butera Dr Laura Melo c e de Almeida Dr Wenchi Shou Lavender Liu Shiyamini Ratnasabapathy Alyce Coleman

AUBEA 2022 Scientific Committee

Professor Mike Kagioglou, Western Sydney University Professor Srinath Perera, Western Sydney University Professor Vivian Tam, Western Sydney University Associate Professor Yingbin Feng, Western Sydney University Associate Professor Mary Hardie, Western Sydney University Associate Professor Xiaohua Jin, Western Sydney University Associate Professor Payam Rahnamayiezekavat, Western Sydney University Associate Professor Swapan Saha, Western Sydney University Associate Professor Sepani Senaratne, Western Sydney University Associate Professor Ajibade Aibinu, The University of Melbourne Associate Professor Guillermo Aranda-Mena, RMIT University Professor Albert Chan, The Hong Kong Polytechnic University Associate Professor Nicholas Chileshe, University of South Australia Associate Professor Vaughan Coffey, Queensland University of Technology Dr Wallace Enegbuma, Victoria University of Wellington Professor Valerie Francis, The University of Melbourne Associate Professor Thayaparan Gajendran, The University of Newcastle Professor Usha Iyer-Raniga, RMIT University Dr Marcus Jefferies, The University of Newcastle Professor Imriyas Kamardeen, Deakin University Associate Professor Yongjian Ke, University of Technology Sydney Associate Professor Linda Kestle, Unitec Professor Farzad Khosrowshahi, Victoria University Associate Professor Chyi Lin Lee, The University of New South Wales Professor Charles Lemckert, University of Canberra Professor Martin Loosemore, University of Technology Sydney Professor Tayyab Maqsood, RMIT University Associate Professor Jasper Mbachu, Bond University Associate Professor Dane Miller, Bond University Professor Anthony Mills, Deakin University Professor Henry Odeyinka, Obafemi Awolowo University Associate Professor Alfred Olatunji, University of Southern Queensland Dr Mehran Oraee, The University of Melbourne Dr Vidal Paton-Cole, The University of Melbourne Associate Professor Raufdeen Rameezdeen, University of South Australia Associate Professor James Rotimi, Massey University Associate Professor Willy Sher, The University of Newcastle Associate Professor Peter Smith, University of Technology Sydney Professor Monty Sutrisna, Massey University Professor Zora Vrcelj, Victoria University Professor Ron Wakefield, RMIT University Professor Suzanne Wilkinson, Massey University Professor Peter Wong, RMIT University Professor Peng Wu, Curtin University Associate Professor Bo Xia, Queensland University of Technology Associate Professor Xianbo Zhao, Central Queensland University Professor Jian Zuo, The University of Adelaide

List of Reviewers

Dr Abid Hasan, Deakin University Associate Professor Abid Nadeem, Nazarbayev University Achini Shanika Weerasinghe, Massey University Alan Todhunter, Western Sydney University Dr Alexia Nalewaik, American University Dr Ali Al-Ashwal, Western Sydney University Amer Hijazi, Western Sydney University Dr Amir Ghanbaripour, Bond University Dr An Thi Hoai Le, Massey University Dr Ana Evangelista, Engineering Institute of Technology Dr Andries van Heerden, Massey University Ania Khodabakhshian, Polytechnic University of Milan Dr Aparna Samaraweera, University of South Australia Dr Arezoo Shirazi, University of Technology Sydney Augustine Senanu Komla Kukah, Western Sydney University Associate Professor Awais Piracha, Western Sydney University Dr Azam Zavvari, Massey University Bashir Tijani, Western Sydney University Dr Brendan Kirkland, Western Sydney University Dr Brian Guo, University of Canterbury Dr Bridget T.B Eshun, The Hong Kong Polytechnic University Buddhini Ginigaddara, University of Newcastle Dr Carol Hon, Queensland University of Technology Dr Cheng Zhang, Xi'an Jiaotong-Liverpool University Dr Christopher Jensen, University of Melbourne Dr Daniel van der Walt, University of Canterbury De-Graft Joe Opoku, Western Sydney University Dr Dilum Bandara, Data61, CSIRO Associate Professor Eric Scheepbouwer, University of Canterbury Dr Ernest Kissi, Kwame Nkrumah University of Science and Technology Dr Eziaku Rasheed, Massey University Dr Gayan Wedawatta, Aston University Dr Gayani Karunasena, Deakin University Godslove Ampratwum, Western Sydney University Associate Professor Henry Abanda, Oxford Brookes University Isaac Akomea-Frimpong, Western Sydney University Dr Jun Wang, Western Sydney University Karoline Figueiredo, Federal University of Rio de Janeiro Kasun Gunasekara, Western Sydney University Dr Keivan Bamdad, Western Sydney University Klaudia Jaskula, University College London Kola Olayiwola, Western Sydney University Dr Krisanthi Seneviratne, Western Sydney University Dr Larry Xiancun Hu, University of Canberra Dr Laura Almeida, Western Sydney University Lei Liu, Western Sydney University Dr Leila Moslemi Naeni, University of Technology, Sydney Dr Liyaning Tang, University of Newcastle

Dr Loo Siaw Chuing, Universiti Malaya Dr Marini Samaratunga, Western Sydney University Associate Professor Mark C. Tatum, Auburn University Dr Matt Stevens, Western Sydney University Dr Matteo Donato, Deakin University Dr Md Kamrul Hassan, Western Sydney University Mohammed Hummadi, Western Sydney University Dr Mohan Siriwardena, Liverpool John Moores University Associate Professor Mohd Suhaimi Mohd Danuri, Universiti Malaya Dr Morteza Alizadeh, Engineering Institute of Technology Dr Muhammad Nateque Mahmood, Deakin University Dr Navodana Rodrigo, University of Adelaide Nethmin Pilanawithana, Western Sydney University Dr Nigel Moore, University of Wolverhampton Dr Niluka Domingo, Massey University Assistant Professor Nima Talebian, Bond University Dr Peng Zhang, Western Sydney University Professor Penny Allan, University of Technology Sydney Prasad Perera, Western Sydney University Priyadarshini Das, Western Sydney University Dr Pushpitha Kalutara, Central Queensland University Dr Reza Razavi, Western Sydney University Dr Rita Peihua Zhang, RMIT University Associate Professor Riza Yosia Sunindijo, University of New South Wales Dr Robert Osei-Kyei, Western Sydney University Dr Salman Shooshtarian, RMIT University Dr Sameera Wijesiri Pathirana, Western Sydney University Dr Seng Hansen, Universitas Agung Podomoro Shiyamini Ratnasabapathy, Western Sydney University Dr Susy F. Rostiyanti, Universitas Agung Podomoro Dr Tayyab Ahmad, Polytechnic University Hong Kong Thao Thi Phuong Bui, Massey University Dr Tingting Liu, Griffith University Professor Udayangani Kulatunga, University of Moratuwa Associate Professor Vaughan Coffey, Queensland University of Technology Dr Wenchi Shou, Western Sydney University Professor Yamuna Kaluarachchi, Manchester Metropolitan University Dr Yang Zou, University of Auckland Yijun Zhou, Western Sydney University Dr York Guo, Western Sydney University Dr Zelinna Pablo, Torrens University Dr Zhenan Feng, Massey University

Welcome Message from the Conference Chair



I am delighted and honoured to welcome you to the 45th Australasian Universities Building Education Association (AUBEA) Conference hosted by the School of Engineering, Design, and Built Environment in collaboration with the Centre for Smart Modern Construction, Western Sydney University.

I am confident that AUBEA 2022 will play an important role in encouraging activities in research and development in construction and built environment sectors. The broad theme of 'Global Challenges in a Disrupted World: Smart, Sustainable and Resilient Approaches in the Built Environment' brings together

researchers, educators, students, and industry practitioners to share knowledge, collaborate, reflect, and learn from each other. The context created by Western Sydney University being ranked Number One in 2022 in the Times Higher Education (THE) impact rankings, recognising excellence in our commitment to the UN Sustainable Development Goals, provides an opportunity to identify current issues and contribute towards shaping the future of the construction and built environment sectors. Conducting this year's conference in a hybrid format allows delegates from around the world to attend the sessions on-site and online, enabling wider participation and bringing together a global community.

I thank our distinguished keynote speakers for sharing their knowledge gained through years of experience in industry and academia. I sincerely thank our sponsors for their generosity in supporting the conference. I would also like to express my gratitude to the program committee, scientific committee and all reviewers for their efforts in ensuring a rigorous, double-blind peer review of abstracts and full papers to accept high quality papers for presentation and publication. I gratefully acknowledge the untiring efforts of Professor Srinath Perera, the Chair of the program committee, the AUBEA leadership and membership and all members of the organising committee who contributed towards the success of AUBEA 2022. They have all done an excellent job!

I sincerely hope that all participants at the 45th AUBEA Conference will benefit from the discourse and collaboration and wish you a fruitful and enjoyable experience at Western Sydney University.

Professor Mike Kagioglou

AUBEA 2022 Conference Chair Dean, School of Engineering, Design, and Built Environment Western Sydney University

Welcome Message from the President of AUBEA



Throughout its long history from its inception in 1975, AUBEA has gone through positive changes and experienced widening participation in its annual conferences. This means strengthening its presence in the traditional catchment area of Australasia and attracting serious interest from Asia, Africa, and Europe to earn a reputation as a regional association with global reach. True to its mission to promote and improve teaching and

research in building/construction through communication, collaboration and scholarly events, AUBEA has become the platform for academics, industry practitioners and students in building to exchange good practices in educating the next generation of building professionals. I genuinely believe in the Triple Helix model of innovation, where government, tertiary education and industry work in unison to drive innovation in a country. Therefore, I am delighted to oversee the direction AUBEA is travelling and confident that AUBEA is on the right track to becoming a truly global phenomenon.

The 45th AUBEA Conference is hosted by Western Sydney University this year. As the entire world is resuming normality from the disruptive global impact of COVID-19, it is great to see that this year's AUBEA Conference is offered in a hybrid mode. This provides opportunities for loyal as well as new AUBEA delegates to attend this annual global gathering despite their different circumstances. I am thankful and would like to commend the hard work of the organising committee to host a successful AUBEA 2022. This strongly signals that AUBEA, as an association, continues to be the platform for exchanging ideas and best practices in building/construction education.

Finally, I would like to take this opportunity to show appreciation to our sponsors and all delegates for attending and supporting this year's 45th AUBEA Conference. I would also like to extend this thankful remark to the scientific reviewers and other relevant parties that have supported AUBEA 2022. Your support is extremely meaningful and instrumental to the success of continuing the tradition of holding AUBEA Conferences. The rest of the AUBEA Council and I envision AUBEA continuing to be the platform for educating the next generation of professionals in our building/construction industry in Australasia and beyond. Therefore, we greatly appreciate your strong support for AUBEA Conferences.

Professor Monty Sutrisna President of AUBEA 2020-2022

Message from the Program Committee Chair



It is with immense pleasure that I write this message for the 45th AUBEA Conference. The Centre for Smart Modern Construction (c4SMC) is proud to collaborate with the School of Engineering, Design and Built Environment, Western Sydney University to host AUBEA 2022.

This year's conference theme of 'Global Challenges in a Disrupted World: Smart, Sustainable and Resilient Approaches in the Built Environment' aims to explore the state of the art in research and development in the field of built environment in a post-pandemic world. The call for papers attracted over 140

abstract submissions from researchers worldwide. A double-blind review process was followed for all abstracts and full papers, which yielded 96 accepted papers of high quality. These papers are categorised under seven sub-themes: Construction Project Management, Digitalisation of Construction, Industrialisation of Construction, Sustainability in Built Environment, Resilience in Built Environment, Health & Safety in Construction, and Education in Built Environment. We are also pleased to introduce the inaugural event in the CIB Early Career Researcher Workshop Series: the **CIB Doctoral School - AUBEA 2022**. I sincerely thank all authors for disseminating the outputs of their research through this conference. I extend my gratitude towards the scientific committee and reviewers for their timely support in selecting and refining the conference papers. I also thank the session chairs for their assistance in conducting the paper presentation sessions and the expert panel at the AUBEA 2022 Doctoral School for providing valuable feedback for the participating doctoral researchers.

Our keynote speakers, Davina Rooney, David Chandler OAM, and Professor Peter Shergold AC are prominent individuals in their respective fields. I heartily thank our keynote speakers for spending their valuable time to impart their knowledge, vision, and insights at AUBEA 2022.

I am grateful for the generosity of our Gold Sponsor, the Australian Building Codes Board; Bronze Sponsors, AIQS, the MDPI Buildings Journal, and RMIT University; and supporters, CIOB and CQUniversity. I also acknowledge c4SMC industry contributors for their generosity in funding research for public and industry good.

My heartfelt appreciation goes out to the conference organising committee and specifically for the c4SMC researchers for their significant efforts over many months to successfully bring together this conference. Finally, I thank all delegates for their valuable participation to make AUBEA 2022 a success.

Professor Srinath Perera

Char of the Program Committee – AUBEA 2022 Director Centre for Smart Modern Construction (c4SMC) Chair Professor of Built Environment & Construction Management Western Sydney University

Keynote Speakers

Davina Rooney

Chief Executive Officer, Green Building Council of Australia (GBCA)



Presentation Title: Sustainability Trends and Future Partnerships

A property professional with a passion for sustainability, Davina has led the Green Building Council of Australia since 2019. As a qualified engineer, Davina worked on large-scale construction projects in Sydney and London, and spent nearly a year building an award-winning school in the Himalayas. She devoted a decade to driving sustainability at one of Australia's largest diversified property companies, Stockland, which culminated in Stockland's

recognition as the world's most sustainable property company. Now leading a member organisation with 550-plus members with a combined value of \$46 billion, Davina brings together practical knowledge, on-the-ground experience and a systematic approach to champion leadership in sustainable design and construction. Davina works with government and industry to advocate for supportive policy and transform complex supply chains. Building on a strong legacy of leadership, Davina is elevating the GBCA's reach and impact into new markets. Davina is on the Board of Evolve Housing and the Australian Sustainable Built Environment Council, as well as Chairing the Sustainable Procurement Roundtable for the Sustainable Built Environment National Research Centre. The property industry has recognised Davina's leadership with multiple awards.

David Chandler OAM

New South Wales Building Commissioner



Presentation Title: The Journey from Adjunct Professor to Building Commissioner, 2015 – 2022

David Chandler OAM was appointed NSW Building Commissioner in 2019 after an impressive forty-year career in the Australian construction industry. David is improving the quality of construction and restoring trust in the industry through leading the delivery of Construct NSW Reform Strategy in collaboration with the sector.

The NSW Reform Strategy has involved in modernising the Building Regulator, shifting focus from reactive to pro-active, with a core reliance on digital capability.

David delivered major infrastructure and urban renewal projects including the new Parliament House in Canberra and Sydney's Quay Apartments. As Adjunct Professor in the School of Computing, Engineering and Mathematics at Western Sydney University, David helped shape the next generation of construction professionals and founded the Centre for Smart Modern Construction, which invests in new academic and research capabilities for the construction sector. David was awarded an Order of Australia Medal in 1989 for his services to the construction industry.

Professor Peter Shergold AC

Chancellor, Western Sydney University



Presentation Title: Rethinking Tertiary Education: The Role of IATs

The Board of Trustees elected Professor Peter Shergold AC as its chair and the University's Chancellor in 2010. His term began on 1 January 2011 and has been extended until December 2022. Peter received a B.A. Hons (First Class) in Politics and American Studies from the University of Hull; an M.A. in History at the University of Illinois at Chicago Circle; and a PhD in Economics from London School of Economics. He was awarded a Hon.DLitt

from the University of New South Wales in 2017. Peter migrated to Australia in 1972 to take up a lecturing position at the University of New South Wales. In 1987, Peter became a CEO in the Australian Public Service (APS) for two decades, working with Prime Ministers and Ministers from both sides of politics.

He wrote a major report on project management of major government programs, *Learning from Failure*, which was handed to the Commonwealth government in 2015. He has also chaired reviews into Health Providers' Access to Medicare Card Numbers in 2017, implementation of the National Construction Code, *Building Confidence* in 2018 and Integration, Employment and Settlement outcome for Refugees, *Investing in Refugees, Investing in Australia*, in 2019. He was also chair the Forum on Western Sydney Airport 2017-20.

Peter was made a Member in the Order of Australia (AM) for public service on Australia Day 1996 and was presented with the Centenary Medal in 2003. In 2007, he received Australia's highest award, the Companion in the Order of Australia (AC) for service to the community.

Program Overview

	Wednesday, 23 November
17:00 - 18:00	Registration, Coffee and Tea Venue: KW-P.1.Foyer
	Welcome Reception
10.00	Welcome to Country
18:00 - 19:00	Mr Nicholas Howie Dharug Man from the Boorooberongal Clan
	Venue: John Phillips Library Foyer
	Thursday, 24 November
08:00 - 09:00	Registration, Coffee and Tea Venue: KW-P.1.Foyer
	Plenary Session
	Welcome to Western Sydney University
	Professor Mike Kagioglou Pro Vice-Chancellor, Global Development (UK/Europe) Dean, School of Engineering, Design and Built Environment Western Sydney University
	Address by President of AUBEA
00.00	Professor Monty Sutrisna Head of School, School of Built Environment, College of Sciences Massey University
09:00 - 10:25	Address by President of CIB
	Professor Makarand (Mark) Hastak Dernlan Family Head of Construction Engineering and Management Professor of Civil Engineering Purdue University
	Keynote
	"Sustainability Trends and Future Partnerships"
	Ms Davina Rooney CEO, Green Building Council of Australia
	Venue: KW-P.1.24
10:25 - 10:45	Morning Tea Venue: KW-P.1.60

	Parallel Paper Presentation Session 1				
10:45 - 12:15	Construction Project Management	Education in Built Environment	Resilience in Built Environment	CIB TG124 Net Zero Carbon - Panel Discussion	CIB Doctoral School - AUBEA 2022
	Session Chair: Prof Anthony Mills	Session Chair: Dr Amir Ghanbaripour	Session Chair: Dr Marcus Jefferies	Panel Moderators: A/Prof Sepani Senaratne and Dr Niluka Domingo	Session Chair: Prof Srinath Perera
	KW-P.1.33	KW-P.1.29	KW-P.1.28	KW-P.1.50	KW-P.1.36
12:15 - 13:15	Lunch Venue: KW-P.1.60				
			Plenary Sess	ion	
			Keynote		
13:15 -	"The Jo	urney from Adjur	-	ding Commissioner, 201	5 - 2022"
13:55			David Chandler		
		New S	outh Wales Building		
			Venue: KW-P.1	1.24	
		Paralle	l Paper Presenta	ation Session 2	
14:00 - 15:30	Digitalisation of Construction	Health & Safety in Construction	Resilience in Built Environment	Sustainability in Built Environment	CIB Doctoral School - AUBEA 2022
	Session Chair: Dr Leila Naeni	Session Chair: Prof Imriyas Kamardeen	Session Chair: TBC	Session Chair: A/Prof. Thayaparan Gajendran	Session Chair: A/Prof Yingbin Feng
	KW-P.1.29	KW-P.1.33	KW-P.1.28	KW-P.1.50	KW-P.1.36
15:30 - 16:00	Afternoon Tea Venue: KW-P.1.60				
		Paralle	l Paper Presenta	ation Session 3	
16:00 - 17:15	Construction Project Management	Digitalisation of Construction	Industrialisation of Construction	Sustainability in Built Environment	CIB Doctoral School - AUBEA 2022
	Session Chair: A/Prof Yongjian Ke	Session Chair: Prof Peter SP Wong	Session Chair: Prof Monty Sutrisna	Session Chair: A/Prof. Rameez Rameezdeen	Session Chair: A/Prof. Yingbin Feng
	KW-P.1.33	KW-P.1.29	KW-P.1.28	KW-P.1.50	KW-P.1.36
18:15 - 21:00	Conference Gala Dinner Venue: Panthers Penrith				

Friday, 25 November
Registration, Coffee and Tea Venue: KW-P.1.60
Plenary Session
Keynote
"Rethinking Tertiary Education: The Role of IATs"
Professor Peter Shergold AC Chancellor Western Sydney University
ion by Gold Sponsor - Australian Building Codes Board

"Working Together: An Education Opportunity"

Presentation by Gold Sponsor - Australian

08:00 -

09:00

09:00 -10:15

Professor Gabrielle Wallace, Group Manager NCC Management and Standards Clare Wright, Group Manager NCC Education

Venue: KW-P.1.24

	Parallel Paper Presentation Session 4					
10:20 - 11:20	Construction Project Management		Digitalisation of Construction		Education in Built Environment	
	Session Chair: Dr Rita Peihua Zhang		Session Chair: Dr Navodana Rodrigo		Session Chair: Buddhini Ginigaddara	
	KW-P.1.33		KW-F	P.1.36	KW-P.1.29	
11:20 - 11:40	Morning Tea Venue: KW-P.1.60					
	Р	aralle	l Paper Pres	entation Sessi	ion 5	
11:40 - 12:40	Construction Project Management		ustrialisation Construction	Sustainabili Built Enviror		AUBEA Council
	Session Chair: Dr Janet Mayowa Nwaogu		ssion Chair: na Evangelista	Session Ch Dr Christop Jensen		Meeting
	KW-P.1.33	k	KW-P.1.29	KW-P.1.3	6	KW-P.1.28
12:45 - 13:15			_	Session by Theme Lead ou, Dr Md Kami		an,
	A/Prof Sepani Senaratne, Dr Robert Osei-Kyei, Dr Sameera Wijesiri Pathirana, Dr Brendan Kirkland, A/Prof Yingbin Feng					
	Vote of Thanks					
	Prof Srinath Perera Director, Centre for Smart Modern Construction (c4SMC) Chair Professor of Built Environment & Construction Management Western Sydney University					
			Venue: KW	V-P.1.24		

13:15 -	Lunch
14:00	Venue: KW-P.1.60
14:00 -	Site Visit
16:00	Western Sydney International (Nancy-Bird Walton) Airport

Note: All times are in Australian Eastern Daylight Time (AEDT)

Disclaimer: The information in this program was correct at the time of printing, however is subject to change.

List of Abstracts

Paper ID	Title	Page No.
	Theme: Construction Project Management	1
2362	Insolvency Prediction Models in the Australian Construction Industry: A Proposed Framework <i>Hewa Dunuwilage, Kanchana Nandasena and Samer Skaik</i>	3
2477	Causes and Effects of Cost Overruns in Construction Projects Chinthaka Atapattu, Niluka Domingo and Monty Sutrisna	4
2531	Sustainable Procurement and Modern Slavery Risks in Development and Construction: A Case Study in Australia Vasilios Papastamoulis, Yingbin Feng, Peng Zhang and Marissa Saunders	5
2701	Examining Site–Office Conflict in Construction Contracting: Adding to an Already Stressful and Stagnant Industry <i>Matt Stevens, John Smolders and Ali Alashwal</i>	6
2776	What's in a Job? Indigenous Construction Workers' Employment Preferences George Denny-Smith and Martin Loosemore	7
4057	Review of Maturity Models Developed in the Construction Industry: Definitions, Applications and Methodologies Sara Rashidian, Robin Drogemuller and Sara Omrani	8
4569	Measuring Knowledge Sharing Processes Through Social Network Analysis Within Construction Organisations Navodana Rodrigo, Sepani Senaratne, Xiao-Hua Jin, Srinath Perera and Parya Rezaeian	9
4895	Engaging External Project Stakeholders Within Social Distancing Parameters in Community Development Projects in South Africa Pride Ndlovu and Prisca Simbanegavi	10
4949	Exploring the Factors Affecting the Cost of Quality (COQ) in Construction Industry: A Systematic Literature Review Nandini Sharma and Boeing Laishram	11
4958	Towards Developing a Conceptual Megaproject Management (MPM) System Jery Johnson, Mohan Siriwardena and Suranga Jayasena	12
6467	Understanding the Relevance and Impact of Systems Thinking in the Construction Industry: A Bibliometric Analysis Natalia Ortega, Daniel Paes, Tak Wing Yiu and Monty Sutrisna	13
6538	Establishing the Symbolic Meaning of Buildability: Construction Practitioners' Point of View <i>PLI Wimalaratne and U Kulathunga</i>	14
6820	Recent National Construction Code Changes, Reduced Innovation, and Increased Contractual Risks <i>Christian van der Pump and Eric Scheepbouwer</i>	15

Paper ID	Title	Page No.
7013	Perception of Usefulness of Building Price Data for Decision Makers in Australia Anthony Mills, Argaw Gurmu, Citra Ongkowijoyo, Wenying Yao, Alexia	16
7781	Nalewaik and Imriyas Kamardeen Do Australians Dislike Chinese Investment in Australian Infrastructure Sector? Yongjian Ke, Liyaning Tang and Changqing Zhai	17
8628	Building Wiser: Fostering Excellence in Procurement Risk Governance Rita Peihua Zhang, Yen Pham, Jan Hayes and Nader Naderpajouh	18
8751	Determining the Optimum Risk/Reward for a Mega Infrastructure Project: A Case Study of a 2.5-Kilometre Rail Bridge Project <i>Matt Stevens and Ali Eghbaljoo</i>	19
	Theme: Digitalisation of Construction	20
492	Comparison of Blockchain Solutions from the Perspective of BIM Integration <i>Klaudia Jaskula, Eleni Papadonikolaki and Dimitrios Rovas</i>	21
801	Closing the Existing Circularity Gap in the Building Construction Industry Using Artificial Intelligence: A Systematic Review of Literatures <i>Benjamin I. Oluleye, Daniel W.M. Chan and Prince Antwi-Afari</i>	22
1057	The Use of Virtual Reality in Reducing the Reliance on Human Visual Construction Defects Inspection <i>Will Nicholls and Peter S.P. Wong</i>	23
1140	Exploring the Nexus between Digital Engineering and Systems Engineering and the Role of Information Management Standards <i>Yu Chen and Julie R. Jupp</i>	24
3058	Fuzzy Evaluation of Barriers to Digital Technologies Adoption in the Construction Industry <i>Xichen Chen, Alice Chang-Richards and Tak Wing Yiu</i>	25
3987	A Socio-Technical Model of Digital Design Coordination and Review: A Game Theoretic Approach Julie Jupp, Mohammad Hassan Azizipour and M. Reza Hosseini	26
4352	Towards Detailed Digital Examination of Masonry Railway Bridges Using Terrestrial Laser Scanner <i>Arijit Sen, Saeed Talebi, Song Wu and Mark Shelbourn</i>	27
4894	3D Printing Technology as an Effective Solution for Sustainable Residential Construction in New Zealand <i>Tatiana Poletaeva, Don Amila Sajeevan Samarasinghe, Lorraine Skelton</i> <i>and Zechen Guan</i>	28
5168	Opportunities for Application of Disruptive Technology in a Disaster Management System to Address Gaps in Australian Bushfire Response Marianna Cheklin, Leila Moslemi Naeni and Catherine Killen	29
5436	Developing Machine Learning Models for Building Rehabilitation Cost Prediction Wai Kin Lau, Nipuni Sumanarathna, Yung Yau, Daniel Chi Wing Ho and Tsz Chung Tse	30

Paper ID	Title	Page No.
6042	Challenges and Enablers for Drone Application in the Construction Industry Janet Mayowa Nwaogu, Yang Yang and Albert P.C. Chan	31
6503	Deterministic and Probabilistic Risk Management Methods in Construction Projects: A Systematic Literature Review and Comparative Analysis Ania Khodabakshian, Taija Puolitaival and Linda Kestle	32
6906	Ensuring Trusted and Traceable Construction Certifications with Blockchain: A Conceptual Model <i>G. Thilini Weerasuriya, Srinath Perera and Rodrigo N. Calheiros</i>	33
7590	Smart Adaptive Homes and Their Potential to Improve Space Efficiency and Personalisation <i>Thomas Goessler and Yamuna Kaluarachchi</i>	34
7978	Case Study Observations on the Use of Digital Technologies for Onsite Project Success Hayden Smith, Mary Hardie and Donald Mason	35
	Theme: Industrialisation of Construction	36
1693	A Conceptual Model to Compare the Pipeline and Sector Information in the Construction Industry <i>Arun Kumar Manickavasagam, Mostafa Babaeian Jelodar, Monty</i> <i>Sutrisna, Azam Zavvari, and Teo Susnjak</i>	37
2306	Opportunities for Innovation Competitions for the Australian Construction Industry <i>Christopher A. Jensen</i>	38
3009	Construction Industry Capacity and Capability Evaluation; Application of Modelling Techniques for Resource Allocation in Multi-Project Portfolios Jaleh Sadeghi, Mostafa Babaeian Jelodar and Monty Sutrisna	39
3765	Realising United Nations Sustainable Development Goals through Offsite Construction Buddhini Ginigaddara, Marcus Jefferies and William Sher	40
5600	Inconsistent Workloads Hamper the Transportation Construction Sector in New Zealand Nicola West, Jacobus Daniel van der Walt and Eric Scheepbouwer	41
6321	Challenges in Measuring the Construction Sector Capacity: Lessons for New Zealand An Thi Hoai Le, Niluka Domingo and Monty Sutrisna	42
7889	Capacity Modeling for the Construction Industry; An Initial Framework Azam Zavvari, Mostafa Babaeian Jelodar, Monty Sutrisna, Teo Susnjak and Arun Kumar Manickavasagam	43
8484	Student Observations of Technical Innovation in an Australian Construction Company Alexander Kapruziak and Mary Hardie	44

Paper ID	Title	Page No.
	Theme: Sustainability in Built Environment	45
495	Towards Sustainable Consumption: Enhancing the Use of Reprocessed Construction Materials within the Australian Construction Industry <i>Gihan Anuradha Tennakoon, Raufdeen Rameezdeen and Nicholas Chileshe</i>	47
907	Outsourcing and Insourcing Construction 4.0 Technologies for Sustainability in the Nigerian Construction Industry <i>Fortune Aigbe, Clinton Aigbavboa and Lekan Amusan</i>	48
938	Barriers and Enablers of the Adoption of Recycled Materials Usage in Asphalt Pavement for the USA and Australia: A Systematic Review <i>Timothy Cassidy, Muhammad Nateque Mahmood and Argaw Gurmu</i>	49
1060	Estimating the Life Cycle Energy Consumption of Urban Residential Buildings Based on A New System Boundary: An Empirical Study of China Lei Liu, Vivian W.Y. Tam, and Khoa N. Le	50
1414	Behavioral Attitudes of Construction Professionals Towards the Industry's Waste Minimization Culture: A Factor Analysis of Key Influential Factors <i>Benjamin Kwaku Ababio, Weisheng Lu and Prince Antwi-Afari</i>	51
4130	A Decision Support Tool for Designing out Waste in Construction Projects: A Conceptual Framework Nguyet Tong, Niluka Domingo and An Thi Hoai Le	52
4416	Exploring Critical Success Factors for Promoting a Circular Economy in New Zealand Construction <i>Kam Yuen Cheng and Yuwei Xia</i>	53
5606	A Review of Residential Construction Waste Reduction Hadeel Albsoul, Dat Tien Doan, Itohan Esther Aigwi and Ali GhaffarianHoseini	54
6029	Challenges to Zero Carbon Refurbishment of Existing Buildings in New Zealand: An Exploratory Study Thao Thi Phuong Bui, Niluka Domingo, Suzanne Wilkinson and Casimir MacGregor	55
6138	Incentivization of Sustainable Waste Management Solutions for Commercial Construction in Australia <i>Pieter van der Lans, Christopher Jensen and Mehran Oraee</i>	56
6928	Revealing the Value of the Circular Economy as a Solution for Mitigating Waste Implications Within the Construction Industry Nathan Johns, Saeed Talebi, David Edwards, Chris Roberts and Mark Shelborne	57
8163	Opportunities for Energy Efficiency Using Biomimicry Strategies in the Construction Industry Nicholas Donohoe, Alan Todhunter and Laura Almeida	58
8402	A Conceptual Framework for Carbon Trading in the Construction Industry Augustine Senanu Komla Kukah, Xiaohua Jin, Robert Osei-Kyei and Srinath Perera	59
8506	Estimation of Construction and Demolition Waste using Meta-Analysis Ali Alashwal and Awornit Shrestha	60

Paper ID	Title	Page No.
9307	Developing an Assessment System on Green Construction Sites in Australia Xiancun Hu, Sarah Elattar, Aifang Wei and Charles Lemckert	61
	Theme: Resilience in Built Environment	62
1173	The Adaptation of the Facility Condition Index (FCI) in the Australian Tertiary Education Sectors Management of a Building Portfolio Jye West, Milind Siddhpura, Ana Evangelista and Assed Haddad	63
1712	Climate Change Impact on Cooling and Heating Demand of Buildings in Penrith Mohammadreza Khanarmuei, Keivan Bamdad and Srinath Perera	64
1756	An A-Priori Framework for Community Transformation through Inclusive Risk-Sensitive Urban Development Devindi Geekiyanage, Terrence Fernando and Kaushal Keraminiyage	65
4358	Overview of New Zealand legislation for Flood Resilience Widi Auliagisni, Suzanne Wilkinson and Mohamed Elkharboutly	66
4791	Comparative Response Spectrum Analysis on 15 Storey Reinforced Concrete Buildings Having Shear Walls with and without Openings as per EN1998-1 Seismic Code <i>Mistreselasie S. Abate, Ana Catarina Jorge Evangelista and Vivian W.Y.</i> <i>Tam</i>	67
5203	Resilience of Post-Resource Landscapes Sarvin Elahi, Penny Allan and James Melsom	68
6085	Evolutionary Designed Building Skins with Embedded Biomimetic Adaptation Lessons Saam Kaviani, Yamuna Kaluarachchi, Federico Rossi and George Ofori	69
6724	Unrecognised Ramifications of Base Isolators in Buildings Ronwyn Coulson, Eric Scheepbouwer and Daniel Van Der Walt	70
7847	Inefficient Regulations that Worsen the Housing Crisis Christian van der Pump and Eric Scheepbouwer	71
9783	Contractor Bankruptcies in the Australian Construction Industry: Causes and Impacts Matt Stevens and Awais Piracha	72
9885	A Tale of Two Projects Robert Mulligan, Regan Potangaroa and Suzanne Wilkinson	73
	Theme: Health and Safety in Construction	74
2938	Modelling Stressor Interconnectivities and Mental Wellbeing Among Construction Workers Imriyas Kamardeen, Abid Hasan and Anthony Mills	75
5003	Scientometric Analysis and Review of Safety in Design in AEC Industry Weifang Shi, Alice Chang-Richards and Brian H.W. Guo	76
6104	Recent National Construction Code Changes, Reduced Innovation, and Increased Contractual Risks <i>Christian van der Pump and Eric Scheepbouwer</i>	77

Paper ID	Title	Page No.
7561	Ontology-based Representation of Implicit and Explicit Knowledge for Job Hazard Analysis: Focusing on Water Infrastructure Jobs Sonali Pandithawatta, Raufdeen Rameezdeen, Seungjun Ahn, Christopher W.K. Chow and Nima Gorjian	78
7594	Conceptual Framework for Suicide Prevention Process in Construction Aparna Samaraweera, TADK Jayasanka, Vidana Gamage Shanika, Rameez Rameezdeen and Sonali Alankarage	79
8031	Re-thinking Spatial Design in Homes to Include Means and Access Restriction with Material Impacts as Passive Suicide Prevention Methods: A Systematic Review of Design for Australian Homes <i>Michael Booth, Pushpitha Kalutara and Neda Abbasi</i>	80
	Theme: Education in Built Environment	81
2079	A Transdisciplinary Learning Approach to Teaching Construction Entrepreneurship Seng Hansen and Susy F. Rostiyanti	83
2407	Construction Engineering and Management: A Review of Australia-based Research <i>Tayyab Ahmad, Husnain Arshad, Qazi and Ajibade Ayodeji Aibinu</i>	84
2565	Impact of the Construction Computing Software (CCS) 'Candy' Course: Construction Management and Quantity Surveying Students' Perceptions John Smallwood, Chris Allen and Ashvin Manga	85
3501	Using 360-Degree Virtual Tours to Teach Construction Students Susan Mander, Vishnupriya Vishnupriya and Ruggiero Lovreglio	86
3725	Taxonomy of Digital Skills Needed in the Construction Industry: A Literature Review Fida Hussain Siddiqui, Amir Abdekhodaee and Muhammad Jamaluddin Thaheem	87
3897	Perceptions of Architecture Degree Students Towards Sustainability in Buildings Tayyab Ahmad and Christhina Candido	88
4262	Retention over Attraction: A Review of Factors Affecting Women's Experiences in the Australian Construction Industry Amir Ghanbaripour, Roksana Jahan Tumpa, Riza Yosia Sunindijo, Weiwei Zhang, Parinaz Yousefian, Ranka Novak Camozzi, Carol Hon, Nima Talebian, Tingting Liu, Mina Hemmati	89
6554	Skill Transformation: Future Requirements, Implementation, and Academic Implications in Quantity Surveying and Construction Management Professionals in the New Zealand Construction Industry <i>Kam Yuen Cheng and Cecily Zhou</i>	90
7703	A Review of Immersive Technology Applications in Occupational Health and Safety Training in the Construction Industry <i>Arka Ghosh and Abid Hasan</i>	91

Paper ID	Title	Page No.
9173	Application of Immersive Technologies in Construction Education: An Experimental Study of Project Scheduling <i>Muhammad Sami Ur Rehman, Narmin Abouelkhier and Muhammad Tariq Shafiq</i>	92
	CIB Doctoral School - AUBEA 2022	93
1123	Community-focused Renewable Energy Transition with Virtual Power Plant in an Australian City – A Case Study <i>Chengyang Liu, Rebecca Yang, and Kaige Wang</i>	95
1371	Dynamic Construction Scheduling and Resource Planning Based on Real- time Project Progress Monitoring Kartika Nur Rahma Putri, Ziang Jiang, Xuesong Shen and Khalegh Barati	96
2026	Issues in Compliance with Low-Carbon Requirements in the Australian Residential Building Industry <i>Yi Lu, Gayani Karunasena and Chunlu Liu</i>	97
3010	A Review of Using Augmented Reality to Improve Construction Productivity <i>Zhidong Xu, Mostafa Babaeian Jelodar, Zhenan Feng and Brian HW Guo</i>	98
3453	Enhancing the Decision-Making Process of Life Cycle Assessment Towards Circular Economy Measurement in the Construction Industry Prince Antwi-Afari, Thomas S.T. Ng, Ji Chen, Benjamin I. Oluleye, Maxwell F. Antwi-Afari and Benjamin K. Ababio	99
3865	A Method for Establishing an Infrastructure of Play within the Houses of Apartment Buildings <i>Dalia Bukhamsin</i>	100
5026	Development of Conceptual Motivational Framework to Improve Construction Labour Productivity in the U.K. John Kojo Tawiah Hayford, Timothy Eccles, Daniel Fong and John Obas Ebohon	101
6400	Optimal BIM and LCA Integration Approach for Embodied Environmental Impact Assessment in Early Building Design <i>Yijun Zhou, Vivian WY Tam and Khoa N. Le</i>	102
6574	Identifying the Validity of Success Indicators in the 'Build Back Better' Approach Francis Hubbard and Regan Potangaroa	103
7556	Buildings' Indoor Environmental Conditions: A Thematic Analysis of Verbatim Comments from University Library Stakeholders De-Graft Joe Opoku, Srinath Perera, Robert Osei-Kyei, Maria Rashidi, Keivan Bamdad and Tosin Famakinwa	104
8584	Improving Decision-making of Building Projects Towards a Smart and Sustainable Future via the Integration of Life Cycle Sustainability Assessment and BIM-based Digital Twin Karoline Figueiredo, Vivian W.Y. Tam, Ana C.J. Evangelista and Assed Haddad	105

Paper ID	Title	Page No.
8611	Self-rated Motivational Drivers for Occupant Behaviours: A Case Study of Tertiary Office Buildings Achini Shanika Weerasinghe, Eziaku Onyeizu Rasheed and James Olabode Bamidele Rotimi	106
9104	Sustainability-Enabling Field in Mega Transport Projects: Insights from Two Cases in India Nicola Thounaojam, Ganesh Devkar and Boeing Laishram	107
9300	Reaching Net-Zero Targets in the Construction Industry by 2050: Critical Review of the Role of Public-Private Partnerships <i>Isaac Akomea-Frimpong, Xiaohua Jin and Robert Osei-Kyei</i>	108

Theme:

Construction Project Management

The 45th AUBEA Conference, 23-25 Nov. 2022, Western Sydney University, Australia

This page is intentionally left blank

Insolvency Prediction Models in the Australian Construction Industry: A Proposed Framework

Hewa Dunuwilage Kanchana Nandasena^{1*} and Samer Skaik²

^{1*}School of Engineering and Technology, Central Queensland University, Brisbane QLD 4000, AUSTRALIA
²School of Engineering and Technology, Central Queensland University Melbourne, VIC 3000, AUSTRALIA

h.nandasena@cqu.edu.au; s.skaik@cqu.edu.au

* Corresponding author

Abstract:

Construction firms have long been very vulnerable to insolvency risk compared to their counterparts in other industries. The severity of insolvency causes has led to the development of numerous prediction models to implement remedies by forecasting the financial status of the company. The effectiveness of these models is usually criticised with regard to the capability of insolvency factors in addressing the dominant causes. This paper aims to develop a framework of factors that can address insolvency causes of the Australian construction industry. A systematic literature review is adopted to identify the factors required to build an effective prediction model. The Australian Securities and Investments Commission Insolvency Statistics Reports' results are triangulated with the systematic review findings to develop the framework. The study reveals that the critical quantitative factors; profitability, liquidity, leverage, management efficiency, cash flow, and capital structure can predict the insolvency causes in Australia. The financial related causes predominantly influence the insolvencies of any country, but the qualitative factors are too inseparable. The positions of financial factors are a result of qualitative factors such as strategic management of the business, macroeconomic conditions, characteristics of the owner, manager, contractor, and company. All those factors are significant, nevertheless, the priority or the ranking may vary depending on insolvency causes relevant to a country or a region. The consideration of integrating the qualitative and quantitative factors to develop an effective insolvency prediction model is thus manifested.

Keywords:

Australian construction industry, Bankruptcy, Insolvency factors, Prediction models, Systematic literature review

Causes and Effects of Cost Overruns in Construction Projects

Chinthaka Atapattu^{1*}, Niluka Domingo¹ and Monty Sutrisna¹

¹School of Built Environment, Massey University, Albany Auckland 0632, NEW ZEALAND

n.d.domingo@massey.ac.nz, m.sutrisna@massey.ac.nz

* Corresponding author

Abstract:

Generally, cost overrun is inevitable in construction projects. However, due to the time, cost, quality constraints, and public impact, roads and highway projects face more significant issues due to cost overruns. Construction projects face a mean cost overrun of 28% inevitably. This paper investigates the causes of cost overruns and their severity based on a systematic literature review. The final selection and analysis are based on 142 journal articles. Collected journal papers were analysed using science mapping and thematic analysis. Quantitative results identified that project management, risk assessment, cost-benefit analysis, construction management, time overrun, decisionmaking, and design/ methodology/ approach triggers a significant effect on cost overruns. The major causes were categorised into three major divisions as management related issues, design/ methodology/approach-related issues, and project performance issues. The Thematic analysis was presented in the form of a fishbone diagram. It is recommended to have a proper management process from both consultant and contractor perspectives as project management and construction management are two significant causes identified. The identified causes will be investigated using actual data from the construction industry and accommodated into a cost estimation model which will minimise the inevitable cost overrun percentage. The research is limited to the literature findings of the past ten-year period. The study offers academics a comprehensive understanding of construction cost overrun (CCO) research to link current research areas to future trends. It also provides construction professionals with current practices and an interdisciplinary guide to better deliver construction projects.

Keywords:

Budget overruns, Causes, Cost overruns, Cost estimation, Construction, Effects

Sustainable Procurement and Modern Slavery Risks in Development and Construction: A Case Study in Australia

Vasilios Papastamoulis¹, Yingbin Feng^{1*}, Peng Zhang¹ and Marissa Saunders²

 ¹School of Engineering Design & Built Environment, Western Sydney University, Locked Bag 1797 Penrith NSW 2751, AUSTRALIA
 ²Stockland, Level 25, 133 Castlereagh Street, Sydney NSW 2000, AUSTRALIA

v.papastamoulis@westernsydney.edu.au; y.feng@westernsydney.edu.au; p.zhang@westernsydney.edu.au; marissa.saunders@stockland.com.au * Corresponding author

Abstract:

Modern Slavery is a global issue as approximately 50 million people were living in modern slavery globally. Construction and property is considered among the top five sectors accountable for modern slavery methods along with 'food and agriculture', 'finance', 'mining' and 'health'. The high fragmentation and complexity of construction projects as well as poor transparency and visibility of the construction supply chain facilitate modern slavery, while the labour shortage due to COVID-19 may exacerbate the problem. It is estimated that 18% of the construction workforce worldwide are modern slavery victims. This number is not negligible as the construction sector itself accounts for 7% of the global workforce. Therefore, minimising modern slavery risks in the construction industry is of great importance. This research aims to examine how sustainable procurement practices can help to minimise such risks across the construction supply chain. A case study with a private listed organisation from the Australian property and building sector was conducted. Data were collected through document review and interviews. The framework for enabling sustainable procurement (Feng et al. 2021) was used to analyse the case. The results suggest that best practices such as 'leadership and collaboration', 'policy and governance' and 'supplier engagement' can significantly contribute to the minimisation of modern slavery risks in the construction supply chain. Also, the findings show that novel data management tools such as 'online supplier questionnaires' and 'web interactive dashboards' can be used by construction organisations to effectively identify and address modern slavery risks.

Keywords:

Construction, Descent work, Modern slavery, Sustainable procurement, Social procurement

Examining Site–Office Conflict in Construction Contracting: Adding to an Already Stressful and Stagnant Industry

Matt Stevens^{1*}, John Smolders¹ and Ali Alashwal¹

¹School of Engineering Design & Built Environment, Western Sydney University, Locked Bag 1797 Penrith NSW 2751, AUSTRALIA

matt.stevens@westernsydney.edu.au; j.smolders@westernsydney.edu.au; a.al-ashwal@westernsydney.edu.au

* Corresponding author

Abstract:

Site workers comprise approximately 80% of construction employment. These personnel deliver outputs that exceed or fall short of the contractor's estimate, such as safety, quality, cost and schedule. However, construction organisations have disparate working conditions and career paths between their site and office staff. Other factors, such as job security and travel requirements, add to the differences in attitudes toward their office counterparts and construction firms. This paper explores these dynamics and attempts to survey perceptions of these two groups. In construction, craft skill leads to quality which is a high priority. The study found different levels of conflict, but no one reported it as non-existent. It is dependent on the individual and the company for which they work. The data points to a need for continuing discussion and inclusion of all company members about the motivators and demotivators, especially those who staff the site. With turnover rates in triple-digit percentages in recent years, adding higher site-office conflict can lead to increased disloyalty to employers, decreased project performance and less labour availability.

Keywords:

Construction personnel, Contracting human resources, Field office, Interpersonal conflict

What's in a Job? Indigenous Construction Workers' Employment Preferences

George Denny-Smith^{1*} and Martin Loosemore²

 ¹RPS | Social Advisory and Research, Level 13/420 George St, Sydney, NSW 2000, AUSTRALIA
 ²Faculty of Architecture and Building, University of Technology Sydney, PO Box 123 Broadway NSW 2007, AUSTRALIA

george.denny-smith@rpsgroup.com.au; Martin.Loosemore@uts.edu.au * Corresponding author

Abstract:

Indigenous procurement policies (IPPs) have created more business and employment opportunities for Indigenous Australians. IPPs in Australia require contractors tendering on government-funded projects to include more Indigenous businesses and employees in supply chains. This type of social procurement, as it is called, is a new approach to addressing the complex socioeconomic inequities experienced by Indigenous Australians through market-driven business and employment opportunities and create social value with Indigenous businesses and workers. But although IPPs have increased demand for Indigenous construction workers, Indigenous Australians continue to experience racial discrimination in the workplace. Therefore, the aim of this paper is to mobilise culturaland construction-specific employer of choice insights to investigate construction practices contributing to social sustainability in an Indigenous procurement context. Drawing on a sample of 31 Indigenous respondents to an online survey, the results indicate that Indigenous construction workers prefer workplaces that have culture benefits (looking after families and communities and cultural security) and are culturally responsive and have structured career progression pathways when selecting a job. The results presented in this paper are a significant contribution to promoting social sustainability in the construction industry. Construction managers wanting to promote Indigenous employment on projects or in their companies can use these insights to influence workplaces that promote sustainable employment outcomes with Indigenous staff. Policymakers could also use these insights in policy development and encourage contractors to create workplaces that address discrimination and collaborative solutions to creating social value in the industry.

Keywords:

Employer of choice, Indigenous employment, Indigenous procurement, Social procurement, Social value

Review of Maturity Models Developed in the Construction Industry: Definitions, Applications and Methodologies

Sara Rashidian^{1*}, Robin Drogemuller¹ and Sara Omrani¹

¹School of Architecture & Built Environment, Queensland University of Technology, George Street QLD 4000, AUSTRALIA

sara.rashidian@hdr.qut.edu.au; robin.drogemuller@qut.edu.au; s.omrani@qut.edu.au * Corresponding author

Abstract:

Maturity models (MMs) have emerged as significant tools to support organisations' management. These models demonstrate how the capabilities required to support a specific function or activity can be developed over time. This enables businesses to plan how to build new capabilities, track the current status of implementation of these capabilities, and plan the actions that will lead to the desired outcomes. In recent years, there has been a rise in the use of maturity models (MM) throughout the construction industry. However, no study has reviewed the areas covered by maturity models in this sector. This paper aims to provide insights into the recent updates in the literature on MMs in the field of construction studies, discuss the direction and objectives of the studies in the development of the MMs, and identify the methodology employed to develop the models. The results were obtained through a systematic literature review (SLR) covering the years 2012 to 2022 and by using the PRISMA method to guarantee that reliable references are discovered and incorporated into the investigation of recent developments in research trends, MMs applications, and definitions in the construction industry. Out of 299 publications on MMs in construction, 64 papers on MMs development were chosen, while papers with the goal of evaluating and verifying MMs were removed. The research revealed that the majority of MMs focused on Building Information Modelling (BIM), followed by sustainability and construction safety. In addition, the evaluation indicated a lack of certainty in the methods used to establish the maturity levels and the paper's direction according to the MMs' declared goals.

Keywords:

Construction industry, Domain application, Maturity model, Systematic literature review

Measuring Knowledge Sharing Processes Through Social Network Analysis Within Construction Organisations

Navodana Rodrigo^{1*}, Sepani Senaratne², Xiao-Hua Jin², Srinath Perera² and Parya Rezaeian²

¹School of Architecture and Built Environment, University of Adelaide, Adelaide, SA 5000, AUSTRALIA ²School of Engineering Design & Built Environment, Western Sydney University, Penrith, NSW 2751, AUSTRALIA

navodana.rodrigo@adelaide.edu.au; S.Senaratne@westernsydney.edu.au; xiaohua.Jin@westernsydney.edu.au; srinath.perera@westernsydney.edu.au; 19223373@student.westernsydney.edu.au

* Corresponding author

Abstract:

The construction industry is a knowledge intensive and information dependent industry. Organisations risk losing valuable knowledge, when the employees leave them. Therefore, construction organisations need to nurture opportunities to disseminate knowledge through strengthening knowledge-sharing networks. This study aimed at evaluating the formal and informal knowledge sharing methods in social networks within Australian construction organisations and identifying how knowledge sharing could be improved. Data were collected from two estimating teams in two case studies. The collected data through semi-structured interviews were analysed using UCINET, a Social Network Analysis (SNA) tool, and SNA measures. The findings revealed that one case study consisted of influencers, while the other demonstrated an optimal knowledge sharing structure in both formal and informal knowledge sharing methods. Social networks could vary based on the organisation as well as the individuals' behaviour. Identifying networks with specific issues and taking steps to strengthen networks will enable to achieve optimum knowledge sharing processes. This research offers knowledge sharing good practices for construction organisations to optimise their knowledge sharing processes.

Keywords:

Construction, Formal and informal knowledge sharing methods, Knowledge sharing, Social network analysis, Social networks

Engaging External Project Stakeholders Within Social Distancing Parameters in Community Development Projects in South Africa

Pride Ndlovu^{1*} and Prisca Simbanegavi¹

¹School of Construction Economics and Management, University of the Witwatersrand, Johannesburg, SOUTH AFRICA

pride.ndlovu@wits.ac.za; prisca.simbanegavi@wits.ac.za.

* Corresponding author

Abstract:

External stakeholders are engaged in construction projects to work together with internal stakeholders to achieve project goals. In community development projects, external stakeholders such as local communities play a significant role in influencing the project as typically, they are the end user of the product at completion. However, engaging external stakeholders whilst adhering to health protocols imposed during COVID-19 in an unequal country like South Africa is intricate. This study aims to explore challenges faced by construction project managers in engaging external stakeholders in community development projects the during COVID-19 period. The study adopts a qualitative design and uses in-depth interviews to source data from construction project managers. A purposive sampling technique was used and sampled construction project managers who were actively managing projects during the COVID-19 pandemic period in South Africa. 15 in-depth interviews were conducted. Thematic analysis of data was used, and six themes emerged from the data. The challenges were centered around six themes namely: communication difficulties; access restrictions; unintentional exclusions; lack of connectivity (power and internet); lack of access to information (misinformation) and inadequate infrastructure. These findings revealed gaps in engaging external stakeholders in a social distancing context of unequally resourced stakeholders in community development projects. Construction project managers could use the recommendations provided to enhance their approach to engaging with external stakeholders in community development projects during a similar crisis.

Keywords:

COVID-19, Construction, External stakeholders, Stakeholders, Stakeholder engagement, Social distancing

Exploring the Factors Affecting the Cost of Quality (COQ) in Construction Industry: A Systematic Literature Review

Nandini Sharma¹ and Boeing Laishram²

¹Research Scholar, Department of Civil Engineering, Indian Institute of Technology Guwahati, Guwahati, 781039, Assam, INDIA
²Professor, Department of Civil Engineering, Indian Institute of Technology Guwahati, Guwahati, 781039, Assam, INDIA

nandini.sharma@iitg.ac.in; boeing@iitg.ac.in

* Corresponding author

Abstract:

In the construction industry, one of the most important concerns is how to establish the optimal balance between the desired standard of quality and the cost incurred. The evaluation of the cost of quality (COQ) can help achieve this balance. Understanding the factors that influence the cost of quality in the construction industry (CI) may assist in identifying cost-saving methods without compromising quality. Even while manufacturing has a well-developed understanding of the components and theories of cost of quality, there is a lack of data accessible from the construction industry for multiple reasons. The study aims to review and analyse literature to identify the factors affecting the cost of quality in construction industry and group them into respective themes. The study is performed utilising 55 peer-reviewed publications on COQ extracted from three databases, i.e., EBSCO Host, Scopus & Web of science. Using the Systematic Literature Review (SLR) strategy, the publications are organised according to the technologies employed so that new directions may be discovered in the existing literature. Thus, this study contributes to the body of knowledge by developing an integration framework of factors that can help industry practitioners, policy makers, and researchers promote COQ & Quality Management in the construction industry. Directions for future research are proposed to address the gaps in literature and enhance effective research towards promoting COQ.

Keywords:

CI, Cost of quality, Framework, SLR, Themes

Towards Developing a Conceptual Megaproject Management (MPM) System

Jery Johnson^{1*}, Mohan Siriwardena² and Suranga Jayasena³

¹RMIT University, AUSTRALIA ²Liverpool John Moores University, UNITED KINGDOM ³University of Moratuwa, SRI LANKA

antony@abacau.com.au; m.l.siriwardena@ljmu.ac.uk; suranga@becon.mrt.ac.lk * Corresponding author

Abstract:

The importance of an effective MPM system has been strongly emphasized in the literature, with UK advocating for the necessary reforms, and Australia following the suit. However, no comprehensive system has been forthcoming to date. Traditionally Megaprojects had been affected by poor performance in terms of cost, time, benefits etc. The literature indicates that project size, number, and investments in Megaprojects are growing globally. Thus, ensuring better performance through adopting MPM best practices is currently very important task for PMs. With current level of awareness about the poor performance of Megaprojects and several challenges related to MPM, there is an urgent need to find suitable practical solutions to overcome the relevant practical and pressing issues. This paper reports on the results of a systematic literature review carried out to develop a conceptual MPM system. The presented MPM framework comprises 18 main elements with each having a number of key points/sub-elements for consideration. Once validated, the system could also be used for the evaluation of MPM practices especially during its development stage to provide actionable insights for the management team, and even used at the post-completion evaluation stage to facilitate learning. The need for such a forward-looking performance evaluation system has been highlighted in the literature. As a next step, the derived conceptual MPM system could be validated through field research involving case studies and subsequently applied across Megaprojects consistently to improve MPM practices, and increase the likelihood and predictability of their success.

Keywords:

Development, Evaluation, Management, Megaprojects, System

Understanding the Relevance and Impact of Systems Thinking in the Construction Industry: A Bibliometric Analysis

Natalia Ortega^{1*}, Daniel Paes¹, Tak Wing Yiu¹ and Monty Sutrisna¹

¹School of Built Environment, Massey University Auckland, 0632, NEW ZEALAND

n.ortega@massey.ac.nz, d.paes@massey.ac.nz, t.yiu@massey.ac.nz, m.sutrisna@massey.ac.nz * Corresponding author

Abstract:

The construction industry has been considered a complex system, and the need to better address this complexity through innovative systemic approaches has been coined. Therefore, this study conducts a bibliometric and thematic analysis-based literature review on Systemic or Systems Thinking (ST) and its contributions to the construction industry, identifying research trends, dissemination, implications, and future research directions. This research addresses the knowledge gap using a scientific mapping approach, including systematic bibliometric analysis of the Scopus database and thematic analysis. Findings indicate that while ST research has been growing exponentially in other areas such as Social Science, Business, Management, and Accounting, it is not the case with the construction discipline and industry. The studies examined mainly focus on ST applied to accidents, human factors, safety management, site safety, and performance management. This study describes the characteristics of ST research in other fields and discusses why this topic is underrepresented in the construction domain.

Keywords:

Construction industry, Decision-making, Disruptions, Management, Pandemic, Systems thinking, Systemic thinking

Establishing the Symbolic Meaning of Buildability: Construction Practitioners' Point of View

PLI Wimalaratne^{1*} and U Kulathunga¹

¹Department of Building Economics, University of Moratuwa, Bandaranayake Mawatha, Moratuwa 10400, SRI LANKA

indraniw@uom.lk; ukulatunga@uom.lk

* Corresponding author

Abstract:

Lack of buildability is identified as one of the reasons for poor performance in the construction industry. Construction Industry Research and Information Association (CIRIA) in the UK in 1983 first defined buildability as "the extent to which the design of a building facilitates ease of construction, subject to the overall requirements for the completed building". Since then, numerous studies have focused on various phases and aspects of construction projects to strive for better project performance through improving buildability. To date, the buildability discourse on various definitions, generic explanations, and guidelines are loosely focused around aspects that can improve construction performance. However, a detailed interpretation of buildability concept as to its in-depth meaning and how the construction professionals experience this concept is not adequately explored. Buildability is a concept that is born and brought up within the construction industry and continues to serve the industry itself. Therefore, exploring the industry view on this concept to understand what is being represented or implied through this term can help establish clear mechanisms that could improve construction project performance. Accordingly, the aim of this paper is to establish a discourse on symbolic meaning of buildability from the industry practitioners' point of view. This research explores the lived experience of industry practitioners on buildability perceptions. Expert interviews using a phenomenological approach is used as the data collection technique. The term buildability is deconstructed from construction practitioners' point of view. This deconstruction facilitates further research on establishing a clear set of guidance that can improve buildability throughout the construction project stages to improve performance.

Keywords:

Buildability, Construction, Lived experiences, Performance, Phenomenology

Recent National Construction Code Changes, Reduced Innovation, and Increased Contractual Risks

Christian van der Pump^{1*} and Eric Scheepbouwer¹

¹ Department of Civil and Natural Resources, University of Canterbury, Private Bag 4800, Christchurch 8140, NEW ZEALAND

christian.vanderpump@pg.canterbury.ac.nz; eric.scheepbouwer@canterbury.ac.nz * Corresponding author

Abstract:

A new clause recently added to the National Construction Code (A2.2(4)) has fundamentally changed the way performance-based design is developed. Previously, designers could formulate a design that was compliant as long as the applicable performance clauses of the National Construction Code were met. This freedom of design allowed designers to compete freely on innovation grounds as opposed to solely on price. However, on 1 July 2021, the new clause regulated this performance-based design process. Designers can no longer formulate a design that complies with the performance clauses. Now, designers must complete a performance-based design brief to be disclosed and approved by multiple parties, many of whom do not have an approval's role, contractual role, or suitable expertise. This process can represent a significant financial risk to developers since assumptions about how land may be built at the development approval stage may be inefficient if some parties do not agree to the performance-based design methodology for other than safety reasons. This new clause does not, by the authors' research, comply with the statutory Acts under which the National Construction Code is passed.

Keywords:

A2.2(4), Building confidence report, Combustible cladding, National Construction Code, Performance-based design brief

Perception of Usefulness of Building Price Data for Decision Makers in Australia

Anthony Mills^{1*}, Argaw Gurmu¹, Citra Ongkowijoyo¹, Wenying Yao², Alexia Nalewaik³ and Imriyas Kamardeen¹

¹School of Architecture & Built Environment, Deakin University, Locked Bag 20001. Geelong VIC 3220, AUSTRALIA ²University of Melbourne, AUSTRALIA ³American University, UNITED STATES

anthony.mills@deakin.edu.au; argaw.gurmu@deakin.edu.au; citra.ongkowijoyo@deakin.edu.au; w.yao@mbs.edu; dralexia@earthlink.net; imriyas.kamardeen@deakin.edu.au * Corresponding author

Abstract:

The objective of this research was to develop a deeper understanding of user expectations of cost data published in Australia. The Australian Institute of Quantity Surveyors (AIQS) has been producing building price information for 60 years, in the belief that members find it useful. However, the quality and value of the data has never been examined. The research data was collected from a survey of industry stakeholders. The study revealed the AIQS cost data is perceived to be a robust and reliable indicator of the market. While respondents reported it has been occasionally used for a variety of purposes, including cost planning and benchmarking, the information was not extensively used by industry. The study sought to understand what was valued by users, and how construction cost data was used in business decision-making. The research offers new insight into the interplay between providers and users. The paper offers practical help to those involved in developing or improving construction cost information, which creates a platform to promote the role of quantity surveyors (QS's) in the industry.

Keywords:

Building economics, Construction cost, Decision-making, Price indices

Do Australians Dislike Chinese Investment in Australian Infrastructure Sector?

Yongjian Ke^{1*}, Liyaning Tang² and Changqing Zhai³

¹School of Built Environment, University of Technology Sydney Ultimo NSW 2007, AUSTRALIA
²School of Architecture & Built Environment, University of Newcastle Callaghan NSW 2308, AUSTRALIA
³Australian Artificial Intelligence Institute, Faculty of Engineering and Information Technology, University of Technology Sydney, Ultimo NSW 2007, AUSTRALIA

yongjian.ke@uts.edu.au; maggie.tang@newcastle.edu.au; changing.s.zhai@student.uts.edu.au * Corresponding author

Abstract:

Chinese investors feel discriminated against by Australian officials and the mainstream media, and some case studies validated the Australian anxiety and discourse on China. But it is unknown whether the general public holds the same attitude. This research hence aimed to examine the public perceptions of general Australians on Chinese investment in Australia on social media. The infrastructure sector was chosen to study, and the Twitter platform was chosen for data collection. We used Python to retrieve tweets from Twitter accounts with Australian IP addresses using pre-defined relevant keywords and a time range from 2009 to 2021. After cleaning the data, there were 5110 tweets on Chinese investment in Australia and 498 tweets about Chinese investment in the Australian infrastructure sector. A sentiment analysis was then conducted. It was found that the general public is not sharply against but slightly towards Chinese investments in the Australian infrastructure, as evident by the result that there are more positive tweets than negative ones. A noticeable decrease in sentiment was seen in 2016 due to a discussion on the lease of Darwin Port to China and in 2021 because the Federal government teared up Victoria's Belt and Road agreements with China that year. This study contributes to practice by validating the potential of using social media to monitor the public perception of a specific topic in the infrastructure sector.

Keywords:

Chinese investment, Infrastructure, Public perception, Sentiment analysis

Building Wiser: Fostering Excellence in Procurement Risk Governance

Rita Peihua Zhang^{1*}, Yen Pham¹, Jan Hayes¹ and Nader Naderpajouh²

 ¹School of Property, Construction and Project Management, RMIT University, 360 Swanston St., Melbourne, Victoria, 3000, AUSTRALIA
 ²School of Project Management, Faculty of Engineering, University of Sydney, Level 2, 21 Ross St, Forest Lodge, NSW, 2037, AUSTRALIA

rita.zhang@rmit.edu.au; yen.pham@rmit.edu.au; jan.hayes2@rmit.edu.au; nader.naderpajouh@sydney.edu.au

* Corresponding author

Abstract:

Project procurement failures in the infrastructure and engineering domains, including the energy sector, are common and costly both financially and sometimes in terms of human lives. A systematic understanding of procurement risks in the energy sector is lacking, which can hinder the ability to control or mitigate risks to improve project outcomes. A research project is being undertaken with a range of stakeholders in the Australian energy sector to understand their experience with procurement of services or goods and their views on procurement risk management. As fieldwork is underway, only interviews with 25 engineers were analysed to provide preliminary results of procurement issues that affect the ability to meet project expectations. The interview data were analysed using the inductive thematic analysis technique. Data analysis revealed procurement risk factors linked to four major categories, including supply chain coordination and management, supplier, external environment and cooperation and trust. Some risk factors identified are not specific to the energy sector but have also been reported as critical in other engineering and construction sectors, including project planning, supply chain configuration, project scope and specifications, and supplier performance and behaviours. Some risk factors are linked to the Australian energy sector's contextual characteristic of relying on international suppliers, including custody transfer and meeting Australian standards and regulatory requirements. Offshore procurement makes it critical to have appropriate interface management structures and quality control/assurance systems to ensure effective communication and compliance with the specification requirements. Procurement risks identified in the study are used in developing a procurement risk governance framework as the next step of this ongoing research.

Keywords:

Energy sector, Infrastructure project, Procurement risk, Supply chain

Determining the Optimum Risk/Reward for a Mega Infrastructure Project: A Case Study of a 2.5-Kilometre Rail Bridge Project

Matt Stevens^{1*} and Ali Eghbaljoo²

¹School of Engineering Design & Built Environment, Western Sydney University, Locked Bag 1797 Penrith NSW 2751, AUSTRALIA ²ORBIZ Consulting Pty Ltd, 93 Pickles Street Port Melbourne, VIC 3207, AUSTRALIA

matt.stevens@westernsydney.edu.au; ali.eghbaljoo@orbiz.io

* Corresponding author

Abstract:

Shutdown construction installation operations are logistically and technically challenging when coupled with significantly limited space and restricted material delivery parameters. This case study will examine the pre-mobilisation planning for a publicly sensitive 2.5 rail bridge in Melbourne, Australia. It was on the critical path of an AUD 542 million infrastructure project. A leading Lean Consulting Firm organised and facilitated Value Stream Mapping (VSM) working sessions to assist the involved organisations in working through various issues such as material logistics, crew staffing and installation processes to determine the optimum cost/risk balance for stakeholders. The result was a well-balanced and reasoned installation approach which eventuated in better-than-expected outcomes.

Keywords:

Lean construction, Takt time, Theory of constraints, Value stream mapping

Theme:

Digitalisation of Construction

Comparison of Blockchain Solutions from the Perspective of BIM Integration

Klaudia Jaskula^{1*}, Eleni Papadonikolaki¹ and Dimitrios Rovas²

¹Bartlett School of Sustainable Construction, University College London, London, UK ²Bartlett School of Environment, Energy and Resources, University College London, London, UK

k.jaskula@ucl.ac.uk

* Corresponding author

Abstract:

Blockchain technology is gaining a lot of interest from both industry and academia as it provides a high level of security, immutability, and transparency. It might be one of the key enabling technologies towards the fourth industrial revolution of the construction industry. Blockchain has a potential to solve some of the challenges surrounding BIMbased collaboration such as lack of accountability and trust, low security, and protection of data ownership. This paper aims to provide an overview of literature on blockchain and BIM integration and a comparison of blockchain solutions for this type of applications. Forty-six publications were identified and analysed through a systematic literature review process. Furthermore, a thematic analysis was conducted to identify benefits and limitations of different blockchain platforms from the perspective of BIM and blockchain integration. The outcomes of the analysis will help researchers interested in developing such applications to quickly understand the differences between blockchain platforms. Hyperledger Fabric and Ethereum blockchains were identified as two most often used blockchain environments in this domain. Hyperledger Fabric was often a preferred solution in construction industry as it provides privacy and confidentiality for sensitive data, lower transaction cost and lower environmental impact. Recent transfer of the Ethereum blockchain to Proof-of-Stake consensus mechanism may lead to higher adoption of this platform in near future; however, the consequences of the merge should be further investigated.

Keywords:

BIM, Blockchain, Construction industry, Ethereum, Hyperledger

Closing the Existing Circularity Gap in the Building Construction Industry Using Artificial Intelligence: A Systematic Review of Literatures

Benjamin I. Oluleye^{1*}, Daniel W.M. Chan¹ and Prince Antwi-Afari²

¹ Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China
²Department of Civil Engineering, The University of Hong Kong, Pokfulam Road, Hong Kong, China

> benjamin.oluleye@connect.polyu.hk; daniel.w.m.chan@polyu.edu.hk; pantwiaf@connect.hku.hk

*Corresponding author

Abstract:

The Circularity Gap Report 2022 has proven how linear the world is nowadays. The globe can only recycle 8.6% of materials used, which leaves a wider circularity gap of over 90%. To address this unfavourable outcome, the Circularity Gap Report 2022 advocated for a technology-driven circular economy (CE) using artificial intelligence (AI) in the building construction industry (BCI) which is regarded as the most resources intensive sector, to close the existing circularity gap. Researchers in the construction domain are currently making gradual progress in enabling systemic circularity using AI techniques toward closing the circularity gap. However, relevant research findings are still scattered, and no known essential studies have made credible efforts to systemize the results for reference and implementation in practice. This paper aims to conduct a thorough systematic review and evaluation of related studies on AI and CE to understand and evaluate how AI could be applicable in bridging the extant circularity gap. The various application areas of AI along the building life cycle were uncovered including pre-demolition auditing, design for deconstruction, optimization of circular business model, on-site recycling, and reverse logistics. The roadblocks of the AI applications were identified together with forward-looking directions for the wider promotion of AI applications. This study has provided a clear path and roadmap for AI applications in closing the existing circularity gap and enhancing more CE implementation in BCI worldwide.

Keywords:

Artificial intelligence, Circular economy, Circularity gap, Construction industry

The Use of Virtual Reality in Reducing the Reliance on Human Visual Construction Defects Inspection

Will Nicholls¹, and Peter S.P. Wong² *

¹Minicon Construction (Aust) Pty Ltd. Ground Floor, 675 Victoria Street, Abbotsford VIC 3067 AUSTRALIA

² School of Property, Construction and Project Management, RMIT University, 360 Swanston Street, 3000, Melbourne, AUSTRALIA

wnicholls@minicon.com.au; peterspwong@rmit.edu.au

* Corresponding author

Abstract:

Construction defect inspection has been criticised as a lengthy and costly process. This is partly caused by the heavy reliance on in-person site visits. Scarce human resources during the economic downturn, as well as the COVID lockdown measures, exposed the weakness of the current construction defects inspection procedures and the need for alternatives to reduce the reliance on physical site visits. This paper presents a study that aims to investigate the use of virtual reality (VR) techniques in reducing the reliance on human visual construction defects inspections. A systematic literature review, followed by a thematic analysis, was conducted. The results indicate that 'VR marker-based inspection', 'Automatic tracking and defect recording system', and the 'VR featured building information modelling management system' are the three major techniques that can be applied to reduce reliance on human resources in defects checking. The findings of this study provide direction in developing a protocol for immersive defects inspection for construction projects.

Keywords:

Construction defects inspection, Virtual reality

Exploring the Nexus between Digital Engineering and Systems Engineering and the Role of Information Management Standards

Yu Chen^{1*} and Julie R. Jupp¹

¹School of Professional Practice and Leadership, University of Technology Sydney, 81 Broadway Ultimo NSW2007, AUSTRALIA

yu.chen-4@student.ust.edu.au; julie.jupp@uts.edu.au

* Corresponding author

Abstract:

Information management standards provide much needed guidance to the implementation of processes supporting more integrated, digital, and model-based approaches to project delivery and through-life asset information management. These standards impact all stakeholders spanning the planning, acquisition and operational phases of buildings and infrastructure. In Australia, since the release of ISO 19650, a variety of state agency standards for digital engineering have been released in support of new model-based processes. A paucity of studies on the uptake of information management standards translates to a lack of understanding of their prevalence, impact, and perceived value on engineering design activities, and in particular systems engineering tasks surrounding requirements management. This paper provides the first step to providing insights into these standards via an online survey of digital engineering and systems engineering stakeholders. Findings reflect a number of differences in the experiences, interpretations, and applications of these standards between roles and sectors. Findings also reflect a greater perceived impact from government standards over international ones. The study highlights ongoing confusion in the roles and responsibilities of digital engineers and systems engineers, and the lack of interface management between information requirements and physical system requirements throughout design review activities.

Keywords:

Digital engineering, Industry survey, Information management, Standards, Systems engineering.

Fuzzy Evaluation of Barriers to Digital Technologies Adoption in the Construction Industry

Xichen Chen^{1*}, Alice Chang-Richards¹ and Tak Wing Yiu²

¹Department of Civil and Environmental Engineering, The University of Auckland, NEW ZEALAND ²School of Built Environment, Massey University, NEW ZEALAND

xche751@aucklanduni.ac.nz; yan.chang@auckland.ac.nz; T.Yiu@massey.ac.nz * Corresponding author

Abstract:

Despite the benefits of adopting technologies to enhance construction project performance, the uptake of digital technologies (DT) in the New Zealand construction sector is still limited. This research adopted a mixed-method approach comprising a survey of 428 construction companies and semi-structured interviews with 38 industry practitioners to identify critical barriers to the DT adoption. The top three most critical barriers were the status quo industry standards, the lack of interest from the clients, and no financial need/drive for using DT. By using the fuzzy synthetic evaluation (FSE) technique, a DT barrier assessment model was firstly derived from the survey results. An action model was then developed to suggest coping strategies and the corresponding actors for addressing each crucial barrier. The research contributes to construction innovation literature by providing an improved understanding of critical barriers to DT adoption. The assessment model can help organisations to identify the crucial challenges to advance digital transformation of the New Zealand construction sector.

Keywords:

Barrier, Construction, Digital technology (DT), Fuzzy synthetic evaluation (FSE)

A Socio-Technical Model of Digital Design Coordination and Review: A Game Theoretic Approach

Julie Jupp^{1*}, Mohammad Hassan Azizipour² and M. Reza Hosseini³

¹School of Civil & Environmental Engineering, University of Technology Sydney, 81 Broadway Ultimo NSW2007, AUSTRALIA ²School of Art & Architecture, Tarbiat Modares University, IRAN ³School of Architecture and Built Environment, Deakin University, Geelong, AUSTRALIA

julie.jupp@uts.edu.au; m_azizipour@modares.ac.ir; reza.hosseini@deakin.edu.au * Corresponding author

Abstract:

A reported benefit of building information modelling is the ability to visualise and detect hard and soft clashes between design systems via the manual inspection of federated 3D models and the use of automated clash detection. Research has focused on the advantages and value of automation revealing a lack of understanding of the complexities of design coordination and how clashes are resolved within a multidisciplinary team once identified. There is a paucity of support for conflict resolution that accounts for both technical and social considerations of design, and how they can be effectively and efficiently negotiated in a distributed, heterogeneous project environment. This research seeks to address this gap by developing a theoretical foundation for digital design coordination and review. The model is used to analytically and mathematically model and manage design conflict resolution using a game theoretic approach. The research contribution therefore seeks to extend automated clash detection workflows by supporting the resolution and greater control of design conflicts. The paper closes with a discussion of cooperative game theoretic approaches and how these methods can support the automated assignment of hard and soft clashes to collaborating team members.

Keywords:

Automated design conflict resolution, Building Information Modelling, Clash detection, Design coordination and review, Game theory

Towards Detailed Digital Examination of Masonry Railway Bridges Using Terrestrial Laser Scanner

Arijit Sen¹, Saeed Talebi^{2*}, Song Wu¹ and Mark Shelbourn²

¹School of Architecture Design and Built Environment, Nottingham Trent University,50 Shakespeare Street, Nottingham NG1 4FQ, UK.
²School of Engineering & the Built Environment, Birmingham City University, Millennium Point, Curzon Street, Birmingham B4 7XG, UK.

arijit.sen@ntu.ac.uk; Saeed.Talebi@bcu.ac.uk; song.wu@ntu.ac.uk; Mark.Shelbourn@bcu.ac.uk * Corresponding author

Abstract:

Masonry railway bridges make up a significant number of the UK railway network. These bridges require regular condition assessments by transportation authorities to identify and evaluate defects that can result in structural failures. Common defects in such masonry structures are spalling, crack, bulging, joint defects and loss of section. The conventional bridge examination process is highly dependent on visual inspection, that is, an inspector should be on site and, as a result, such inspection can cause health and safety concerns as well as traffic interruption for a significant period. Digital examination process can replace the visual examination and it can subsequently reduce the number of site visits, traffic interruptions, and health and safety concerns. It can eventually speed up the examination process and improve the efficiency of inspectors' work. Terrestrial laser scanner (TLS) can be used to identify defects and analyse their severity on the surface of bridge structures. The point cloud dataset captured by TLS can be analysed using commercially available software packages to identify defects and assess their severity. However, a review of the literature reveals that despite the importance of masonry railway bridges, there is scarce literature focused on exploring and comparing different software solutions for the purpose of defect detection and analysis in such bridges. Therefore, this exploratory research aims to demonstrate the applicability of digital examination for masonry railway bridges through the application of TLS. This paper contributes to knowledge by establishing a practical basis to identify defects in masonry railway bridges using commercially available software tools.

Keywords:

Defect detection, Digital examination, Masonry bridge defects, Point cloud data analysis

3D Printing Technology as an Effective Solution for Sustainable Residential Construction in New Zealand

Tatiana Poletaeva¹, Don Amila Sajeevan Samarasinghe^{2*}, Lorraine Skelton¹ and Zechen Guan²

¹Otago Polytechnic Auckland International Campus, Auckland 1010, New Zealand ²School of Built Environment, College of Sciences, Massey University, Auckland 0632, New Zealand

POLET1@student.op.ac.nz; D.Samarasinghe@massey.ac.nz; Lorraine.Skelton@op.ac.nz; Z.Guan@massey.ac.nz

* Corresponding author

Abstract:

The construction industry contributes to approximately 6% of the global GDP but consumes extensive resources and generates about 30% of the world's carbon emissions. New Zealand's construction industry is significant to the economy but slow to innovate. Emerging digital manufacturing technologies such as 3D Printing has been involved in the manufacturing sector and are becoming popular in the construction industry as a sustainable solution to high carbon emissions. However, an effective method to comprehensively improve the sustainability of building construction has not yet been widely applied. This research explored the overseas experience of 3D printing construction and its sustainability aspects. It identifies how 3D printing technology could be used to improve the current challenges in New Zealand construction. The study recommends how 3D printing technology could be used in New Zealand residential construction for improving its sustainability. Qualitative analysis was chosen as the methodology of this primary research, which included two sets of semi-structured interviews. The first set included interviews with local companies to determine their knowledge, fears and expectations of 3D printing technology. The second set consisted of interviews with overseas companies, where the main focus was on the analysis of the advantages and disadvantages experienced by participants. Thus, the results from both participation groups (experienced overseas and local construction companies) helped to identify the possibilities for 3D printing adaptation in the New Zealand market, and any gaps this technology could cover. 3D printing can be more appropriate for start-ups for small and medium-sized businesses in New Zealand. The technology is environmentally friendly and allows for the use of recycled materials, can use local material for printable products, and can decrease construction waste and CO₂ emissions Portland cement has a high level of pollutants, and many overseas companies are trying to replace it with other materials including products generated by 3D printing. 3D printing improves Health and Safety conditions primarily because of the automatisation of the work process. Time and cost-efficiency also have become an essential part of economic sustainability, so 3D printing technology can give a quick return on investment.

Keywords:

3D printing technology, Building construction, New Zealand, Sustainability

Opportunities for Application of Disruptive Technology in a Disaster Management System to Address Gaps in Australian Bushfire Response

Marianna Cheklin^{1*}, Leila Moslemi Naeni¹ and Catherine Killen¹

¹School of Built Environment, University of Technology, Sydney PO Box 123 Broadway NSW 2007, AUSTRALIA

marianna.cheklin@student.uts.edu.au; leila.mosleminaeni@uts.edu.au; catherine.killen@uts.edu.au * Corresponding author

Abstract:

Australia has recently experienced increasing instances of natural disasters, including floods, drought, and bushfires. The Bushfires in 2019-20, also known as Black Summer, were particularly impactful. This led to an in-depth governmental investigation of its management via Royal Commission and Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO). Key recommendations for an improved disaster management system included removing silos, improve data accuracy and sharing, and using a systems design approach. In response to these reports, this paper explores how disruptive technology- blockchain, intelligent systems, and Intelligent Internet of Things (IIOT)- can be used to improve disaster response, particularly as it applies to bushfires in Australia. The method used to explore this was, first, a review of government reports on the 2019-20 bushfires to identify disaster management gaps and recommendations. Subsequently, a review of available literature was conducted to find how disruptive technology was being applied to disaster management systems. Finally, this paper explores implications of disruptive technology and presents potential next steps in research toward the future creation of a prototype.

Keywords:

Blockchain, Disaster management system, Intelligent Internet of Things, Intelligent systems

Developing Machine Learning Models for Building Rehabilitation Cost Prediction

Wai Kin Lau^{1*}, Nipuni Sumanarathna¹, Yung Yau², Daniel Chi Wing Ho¹ and Tsz Chung Tse¹

¹Department of Environment, Faculty of Design and Environment, Technological and Higher Education Institute of Hong Kong (THEi), 133 Shing Tai Road, Chai Wan, HONG KONG SAR

wkelau@thei.edu.hk; nipuni_s@thei.edu.hk; yungyau@ln.edu.hk; danielho@thei.edu.hk; lawrencetse@thei.edu.hk

* Corresponding author

Abstract:

The ageing of building stock is taking place in high-rise, high-density cities such as Hong Kong. To handle the ageing building stock problem, redevelopment may not be a sustainable solution, while building rehabilitation has long been neglected. Without timely and proper maintenance, dilapidated buildings are urban time bombs that threaten public safety and health. Implementing building rehabilitation, however, is easy to say than done. It requires concerted efforts from different parties, a culture of building care, and financial and other input. Worse still, lack of knowledge and collusive tendering have made the implementation more difficult. Modelling and predicting building rehabilitation cost to provide cost transparency and certainty is a way to accelerate and facilitate rehabilitation works in multi-storey, multi-ownership residential buildings. This study, therefore, seeks to identify factors affecting building rehabilitation cost from a review of previous works and interviews for developing building rehabilitation cost prediction models using machine learning techniques. The use of measures/indicators for evaluating and comparing different building rehabilitation projects is also investigated. The development of the pilot models, the research plan and the preliminary findings are presented in this paper.

Keywords:

Building rehabilitation, High-rise residential buildings, Hong Kong, Machine learning, Predictive modelling

Challenges and Enablers for Drone Application in the Construction Industry

Janet Mayowa Nwaogu^{1*} Yang Yang¹ and Albert P.C. Chan¹

¹Department of Building and Real Estate, The Hong Kong Polytechnic University, Hong Kong, Block Z, 181 Chatham Road South, Hung Hom, HONG KONG, CHINA

janet.nwaogu@connect.polyu.hk; jackie.yyang@polyu.edu.hk; albert.chan@polyu.edu.hk * Corresponding author

Abstract:

Drones are employed for various applications such as inspections, surveying, mapping, and monitoring work progress. These application areas are core aspects of construction activities, thus, increasing drone adoption in the construction industry over the years. However, with the adoption of digital technologies comes factors that influence their use. This study determines the challenges and enablers of using drones in construction by reviewing existing literature and social media discussions. A total of 128 peer-reviewed articles and 460 tweets related to drone adoption in the construction industry were retrieved from the Scopus and Twitter databases, respectively. The data were analysed quantitatively and qualitatively, and themes were developed. The results showed that drone adoption challenges are related to policy issues, safety concerns, and knowledge and awareness. In comparison, the enablers include efficiency and cost reduction. By identifying the factors influencing drone adoption, strategies can be developed to effectively provide construction organisations with the best opportunities to use drones for their construction processes.

Keywords:

AEC, Construction Industry, Challenges, Drone, Enablers, UAVs

Deterministic and Probabilistic Risk Management Methods in Construction Projects: A Systematic Literature Review and Comparative Analysis

Ania Khodabakshian¹, Taija Puolitaival² and Linda Kestle^{3*}

¹ Built Environment and Construction Engineering, Politecnico di Milano, Via Ponzio, 31, 20133, Milan Italy
² Faculty of Built Environment, Tampere University, FI-33014 Tampere University, Finland
^{3*}School of Building Construction, Unitec Institute of Technology, PB 92025, Auckland 1142, New Zealand
*Ikestle@unitec.ac.nz

* Corresponding author

Abstract:

Risks and uncertainties are inevitable in construction projects, and can drastically change the expected outcome, and negatively impact the project's success. However, Risk Management (RM) is still conducted in a manual, ineffective, and experience-based fashion in practice, hindering automation and knowledge transfer to upcoming projects. The Construction industry is recently benefitting from Industry 4.0 revolution and the advancements of Data Science branches such as Artificial Intelligence (AI). This shifts the construction management processes towards digitalization and optimization. Datadriven methods, such as AI and Machine Learning algorithms, Bayesian Inference, and Fuzzy Logic, seem to be a decent solution to RM domain shortcomings and automating and optimizing the RM processes, which are being widely explored recently. These methods are divided into deterministic and probabilistic models, the first of which proposes a fixed predicted value, and the latter, embraces the notion of uncertainty, causal dependencies, and inferences between variables affecting projects' risk when proposing a predicted value. This research uses a systematic literature review to investigate and then comparatively analyse the main deterministic and probabilistic methods applied to Risk Management in the construction industry in respect of each method's specific scope, primary applications, advantages, disadvantages, method limitations, and proven accuracy. The findings will establish the recommendations for optimum AI-based methods and frameworks for different management levels- Strategic, Operational Project Management, and for large or small datasets.

Keywords:

Artificial intelligence, Construction industry, Machine learning algorithms, Project management, Risk management

Ensuring Trusted and Traceable Construction Certifications with Blockchain: A Conceptual Model

G. Thilini Weerasuriya^{1*}, Srinath Perera¹ and Rodrigo N. Calheiros²

¹Centre for Smart Modern Construction (c4SMC), School of Engineering, Design and Built Environment, Western Sydney University, Locked Bag 1797 Penrith NSW 2751, AUSTRALIA
²School of Computer, Data and Mathematical Sciences, Western Sydney University, Locked Bag 1797 Penrith NSW 2751, AUSTRALIA

T.Weerasuriya@westernsydney.edu.au; Srinath.Perera@westernsydney.edu.au; R.Calheiros@westernsydney.edu.au

* Corresponding author

Abstract:

Significant failures in buildings are reported due to poor design, non-compliance to standards, and inadequate oversight, testing, and certification. Clearly traceable inspections, tests, and certifications are required to deter future failures and identify responsible negligent parties. Blockchain provides a secure, decentralised electronic ledger, which prevents unauthorised data manipulation and presents an audit trail with transparency of activities. Blockchain also contains smart contracts that can automatically execute on fulfilment of specified conditions. This paper proposes a conceptual model for a blockchain-based framework to ensure trusted and traceable certifications of construction work, materials, and related payments. The conceptual model was developed based on a critical literature review and problem analysis. Issues related to certifications, limitations of existing software systems in the construction industry, and the suitability of blockchain as a solution were identified from the literature. The conceptual model presents the stakeholders involved in certification, the high-level processes and types of construction certifications, and a blockchain framework to manage the certifications. The blockchain framework comprises of an integrated data model, process model, blockchain prototype, and distributed applications. The conceptual model was validated through an expert forum consisting of industry practitioners. The blockchain framework is expected to enhance the trust and traceability of certification data, thereby allowing the identification of reliable contractors and consultants to improve the performance of the construction industry with fewer defects and building failures.

Keywords:

Blockchain, Conceptual Model, Construction Certification, Traceability, Trust

Smart Adaptive Homes and Their Potential to Improve Space Efficiency and Personalisation

Thomas Goessler^{1*} and Yamuna Kaluarachchi¹

¹ Manchester School of Architecture, Manchester Metropolitan University, UK All Saints Building, Manchester, M15 6BH, United Kingdom

thomas.goessler@stu.mmu.ac.uk; Y.Kaluarachchi@mmu.ac.uk * Corresponding author

Abstract:

Over the last decades, population growth in urban areas and subsequent rising demand for housing have resulted in significant space and housing shortages accompanied by a loss of identity and personalisation in urban homes. This paper investigates the influence of smart technologies on small urban dwellings to make them adaptive, personalised and resilient. The study builds on the hypothesis that smart technology could increase efficiency and space usage up to two to three times compared to a conventional apartment, and could accommodate increased housing demand and give young city dwellers a new housing perspective. A comprehensive semi-systematic literature review including a review of case study projects illustrates different strategies to increase functionality and diminish the physical and psychological limitations of small spaces by making functions time-dependent and introducing furniture and division elements that adapt to user needs in real-time. This paper discusses the two main schools of thought, the idea that technology should be a silent and invisible helper versus the notion of technology as an interacting entity with visual representation. It further categorises types of flexibility and adaption regarding the size of the moving elements and the time that the transformation takes. Together with the analysis of real-world projects, results show that smart and adaptive technology can increase space efficiency by reducing the need for separate physical spaces for different activities. Smart technology substantially increases the versatility and multifunctionality of the room in all three dimensions and allows for adaptation and customisation for a variety of users.

Keywords:

Adaptive homes, Interactive architecture, Micro-living, Smart homes, Space shortage

Case Study Observations on the Use of Digital Technologies for Onsite Project Success

Hayden Smith¹, Mary Hardie^{1*} and Donald Mason¹

¹School of Engineering Design & Built Environment, Western Sydney University, Locked Bag 1797 Penrith NSW 2751, AUSTRALIA

m.hardie@westernsydney.edu.au; donald.mason@westernsydney.edu.au * Corresponding author

Abstract:

The use of digital technologies plays a significant role in the success of construction projects especially with respect to construction safety. Comparatively recent developments have helped to digitise the industry, introducing new technologies which may involve processes, techniques, software and materials. These advances have brought benefits such as reduced costs, minimised waste production, improved design sustainability and increased levels of safety, efficiency, productivity alongside improved quality assurance. The most common barrier towards adoption of these technologies is a lack of knowledge and understanding of their effectiveness. Three case studies of industrial warehouses built in the greater Sydney area are examined for insights into the relationship between the adoption of digital technologies and project success. The study of project records from these case study projects indicates a consistent use of digital tools such as Build SoftTM, Microsoft ProjectTM and AconexTM throughout the design and construction phases. The results also suggest possible supporting evidence for a link between project risk and project duration being impacted by the relative adoption level of the digital tools.

Keywords:

Construction management, Digital technologies, Industrial warehouse projects, Onsite project delivery

Theme:

Industrialisation of Construction

A Conceptual Model to Compare the Pipeline and Sector Information in the Construction Industry

Arun Kumar Manickavasagam¹, Mostafa Babaeian Jelodar², Monty Sutrisna², Azam Zavvari², and Teo Susnjak³

¹Department of Civil & Natural Resources Engineering, University of Canterbury, Christchurch 8041, NEW ZEALAND ²School of Built Environment, Massey University, Auckland, NEW ZEALAND ³School of Mathematical and Computational Sciences, Massey University, Auckland, NEW ZEALAND

arun.manickavasagam@canterbury.ac.nz*; M.B.Jelodar@massey.ac.nz; A.Zavvari@massey.ac.nz; M.Sustrisna@massey.ac.nz; T.Susnjak@massey.ac.nz

* Corresponding author

Abstract:

Responding to the various issues facing the construction sector in New Zealand, particularly the imbalance between the demand (pipeline projects) and supply (the construction sector's ability to deliver), a research project has been developed focusing on the construction supply-demand by evaluating the pipeline of construction work in New Zealand. This is an integral part of the New Zealand Government funded CanConstructNZ research programme to assess and enhance the capacity and capability of the New Zealand construction sector. Due to the complex and dynamic nature of these problems, a system dynamics (SD) model for comparing information from both pipeline and sector sides is explored. In particular, the dataset from the Ministry of Education (MoE) was used as a case study example to illustrate and demonstrate the pipeline submodel. Whilst it was demonstrated that SD holds the potential to be used as the modelling tool, future research will involve more comprehensive and holistic view of the pipeline sub-model. This includes further development of the supply sub-model thus allowing a comparison between the pipeline and sector information.

Keywords:

Construction sector, Case studies, Data, Demand, Supply.

Opportunities for Innovation Competitions for the Australian Construction Industry

Christopher A. Jensen^{1*}

¹Melbourne School of Design, Faculty of Architecture Building and Planning University of Melbourne

cjensen@unimelb.edu.au

*Corresponding author

Abstract:

A large body of knowledge exists relating to the theory of innovation as well as its practical implications. In recent years large scale global technology innovation prizes have become common as a strategy to develop and test innovations, with the rise in success of the format being attributed to the use of the internet, allowing a greater global participation. These large-scale competitions have attracted the attention of many different industries, to the point that U.S. government agencies now use innovation prizes as a procurement strategy. In contrast, construction industry competitions are relatively limited and concentrated at the design stage such as architectural design competitions. This study uses conceptual analysis to understand the relationship between established strengths and weaknesses of the Construction industry, and the essential criteria for industry competitions defined by the Staged Competition Innovation theory, which presents three key principles that lead to a successful industry competition, including 1) a new mechanism for innovation, 2) A unique competition environment, and 3) A pathway for industry adoption. The analysis presented shows that a successful construction competition must be closely aligned with the regulation and practices of the industry to be adopted, and favours organisations with an innovative culture and top management support. Attributes from a construction competition to be avoided would include onerous upfront financial commitments, risk to intellectual property rights and omission of the suppliers and subcontractors in the tasks.

Keywords:

Construction industry, Construction innovation, Innovation competition

Construction Industry Capacity and Capability Evaluation; Application of Modelling Techniques for Resource Allocation in Multi-Project Portfolios

Jaleh Sadeghi^{1*}, Mostafa Babaeian Jelodar¹ and Monty Sutrisna¹

¹School of Built Environment, Massey University, Auckland, New Zealand

j.sadeghi@massey.ac.nz; m.b.jelodar@massey.ac.nz; and M.Sutrisna@massey.ac.nz * Corresponding author

Abstract:

Multiple projects that consume shared resources are handled in a multi-project portfolio (MPP) and can be subject to portfolio management for budget allocation, prioritisation, and timing. An MPP owner may face many challenges finding the best scheduling and resource allocation programs for its in-progress and pipeline projects. In construction project management, complexity and uncertainty problems raise the need for proper construction-related MPP (C-MPP) planning techniques. In a C-MPP, several projects with shared and limited resources shall be executed in a certain period and must be modelled and well-understood. Mathematical and computational modelling techniques have been developed to be compatible with environments with diverse construction projects. These models usually targeted cost balancing, optimal budget allocation and efficient timing programs, to name a few. This paper explores the current theories on C-MPP management and identifies fit-for-purpose modelling techniques. As the outcome, a proposed computational model of the projects and their interdependencies in a portfolio contributes to MPP and C-MPP management area. This conceptual model offers a method for evaluating the capacity and capability of construction enterprises and introduces a significant application for agent-based modelling, i.e., portfolio-level visualisation and resource allocation.

Keywords:

Agent-based modelling, Capability, Construction industry, Multi-project portfolio management, Resource allocation

Realising United Nations Sustainable Development Goals through Offsite Construction

Buddhini Ginigaddara^{1*} Marcus Jefferies¹ and William Sher¹

¹School of Architecture and Built Environment, University of Newcastle, Callaghan, NSW 2308, AUSTRALIA

Buddhini.GinigaddaraAppuhamilage@newcastle.edu.au, marcus.jefferies@newcastle.edu.au, willy.sher@newcastle.edu.au

* Corresponding author

Abstract:

Amalgamating construction and manufacturing processes is referred to as offsite construction (OSC). These deliver buildings that are produced in factories and then transported and erected onsite. In line with the UN's Sustainable Development Goals (SDGs), OSC moves traditional onsite construction methods to potentially more efficient, safe, and sustainable factories with advanced robotics and assembly lines. This paper reviews how OSC assists realisation of the SDGs by achieving targets specified in the SDGs. A systematic literature review (SLR) was conducted, identifying 24 publications in the Scopus database. The SLR was guided by the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) protocol. As only six publications directly referred to 'OSC and SDGs', those on 'construction and SDGs', 'manufacturing and SDGs' and 'prefabrication and SDGs' were also reviewed. The investigation identified five SDGs directly related to OSC. Factory-based manufacturing processes and improved working conditions promoted through OSC help to achieve SDG 8: decent work, and economic growth, SDG 9: industry, innovation, and infrastructure and SDG 12: responsible consumption, and production. Additionally, the use of sustainable materials, renewable energy sources and being cautious about ecology through design for sustainability practices adopted in OSC are in line with SDG 11: sustainable cities and communities, and SDG 13: climate action. This study provides insights into how modern methods of construction, such as OSC, can assist in delivering SDGs. Further, it contributes to knowledge by recognising potential steps to be followed to realise SDGs through OSC in line with current technological advancements.

Keywords:

Offsite construction, Systematic literature review, UN sustainable development goals

Inconsistent Workloads Hamper the Transportation Construction Sector in New Zealand

Nicola West^{1*}, Jacobus Daniel van der Walt¹ and Eric Scheepbouwer¹

¹Department of Civil and Natural Resources Engineering, University of Canterbury, Private Bag 4800 Christchurch 8140, NEW ZEALAND

nicola.winter@pg.canterbury.ac.nz; eric.scheepbouwer@canterbury.ac.nz; daniel.vanderwalt@canterbury.ac.nz

* Corresponding author

Abstract:

The New Zealand Transport Agency spends billions of dollars on infrastructure projects annually and plans to increase the quantity of work in the next 25 years. However, there is a question about the capacity of the construction sector to deliver this quantity of work. The objective of this paper is to present an initial assessment of contract tender data for Government transportation works to provide an overview of resource allocation requirements. Project data gained from the Waka Kotahi NZ Transport Agency (NZTA) through a request under the Official Information Act (OIA) in combination with award notice data published by the NZTA on the Government Electronic Tender Service (GETS) has been used to investigate the amount of transportation work that has been awarded from January 2001 to June 2021. Analysis of contract award dates and amounts showed that the level of resources required to deliver physical works transportation contracts was inconsistent throughout the period. Findings show fluctuation in the number of projects awarded, the percentage of advertised projects awarded, the value of projects awarded, and consequently, the number of labour hours required per year. In other words, the release of government-funded transportation physical works projects is inconsistent. Companies increase their capacity based on expectations of future work. Inconsistencies in actual workloads may not offer the security that companies need. Consequently, it could be unlikely that companies will increase their capacities and cope with an increase in work over the following years. Governmental agencies may find themselves competing for limited construction resources. A strategic release of physical works and transportation projects could level out the demand for construction resources and create continuity for contracting companies. This would help increase the capacity of the construction sector.

Keywords:

Capability, Construction, Contractors, Resource levelling, Transportation work

Challenges in Measuring the Construction Sector Capacity: Lessons for New Zealand

An Thi Hoai Le^{1*}, Niluka Domingo¹ and Monty Sutrisna¹

¹School of Built Environment, Massey University, Auckland 0632, NEW ZEALAND

A.lethihoai@massey.ac.nz; N.D.Domingo@massey.ac.nz, M.Sutrisna@massey.ac.nz * Corresponding author

Abstract:

The construction sector plays a large role in New Zealand's economic development. It has a significant impact on other industries and the nation's wealth and well-being as well. Over the next 25 years, the construction sector is forecasted to deliver over 90 billion in infrastructure, residential and non-residential pipeline projects in New Zealand. However, concerns about the ability of the industry to deliver expected demands have been raised due to capacity limitations urging the demand to understand the current sector capacity. This study conducted a narrative literature review to investigate different aspects of measuring the construction sector capacity, including examining existing measuring models. Findings from the literature review found various challenges in measuring the sector capacity and limited access to required data. The findings provide a fundamental step for future research to identify indicators and methods to help measure New Zealand's construction sector capacity.

Keywords:

Capacity development, Construction industry, Measuring capacity, New Zealand

Capacity Modeling for the Construction Industry; An Initial Framework

Azam Zavvari^{1*}, Mostafa Babaeian Jelodar¹, Monty Sutrisna¹, Teo Susnjak² and Arun Kumar Manickavasagam³

 ¹School of Built Environment, Massey University East Precinct Albany Expressway, SH17, Albany, Auckland 0632
 ²School of Mathematical and Computational Sciences, Massey University East Precinct Albany Expressway, SH17, Albany, Auckland 0632
 ³Department of Civil and Natural Resources Engineering, University of Canterbury, Christchurch 8041, NEW ZEALAND

a.zavvari@massey.ac.nz, m.b.jelodar@massey.ac.nz, m.sutrisna@massey.ac.nz, t.susnjak@massey.ac.nz, arun.manickavasagam@canterbury.ac.nz

Abstract:

Similar to any other industry and associated sectors it is critical for significant stakeholders involved in construction activities to understand demand and supply and how this determines capacity. Evaluating capacity is essential for meaningful future work planning in any industry. However, at such levels of planning, the construction industry has traditionally faced many uncertainties and issues. This is associated to the projectbased and inherently fragmented nature of the industry with poor record keeping and information sharing. This study focuses on construction capacity by evaluating the pipeline of construction work and the sectors associated with the pipeline. The main aim of this study is to create a model for comparing characteristics of the pipeline and sector data to assess and improve capacity in the New Zealand construction sector. The methodological approach used in this study is a mixed methodology based on a literature review and a case study from the New Zealand construction industry. A review of the literature aided the authors in the first stage of addressing supply and demand issues in the construction industry. The construction-related data was then used in a case study approach to develop the conceptual framework to predict the capacity of the market. Accordingly, a model concept is developed based on the properties of the sector associated with the pipeline of projects. The proposed concept enables capacity modelling; a review is provided on the evolution of capacity models for use in construction systems planning and investment and an initial capacity model is proposed and discussed.

Keywords:

Capacity, Complexity, Construction, Modelling, Sector

Student Observations of Technical Innovation in an Australian Construction Company

Alexander Kapruziak¹ and Mary Hardie^{1*}

¹School of Engineering Design & Built Environment, Western Sydney University, Locked Bag 1797 Penrith NSW 2751, AUSTRALIA

m.hardie@westernsydney.edu.au, 18454853@student.westernsydney.edu.au * Corresponding author

Abstract:

Technical innovations in the construction industry shape both the present and the future development of the industry. Technical innovation can be described as the application of knowledge about tools, materials, processes, and techniques to problem solving. Innovation thus combines the science of discovery and the process of change delivery. Innovation can lead to the creation of social and economic value. It also enables a competitive advantage for the companies who make it their method of operation. A systematic study was undertaken to observe, assess and evaluate technological innovation examples within one construction company. Through the examination of the deployment of specific innovations including Building Information Modelling (BIM) in project delivery, central electronic record keeping and digital construction scheduling, this study examines how various technical changes have impacted project delivery. This observational study provides an evaluation of what makes these practices successful. Innovation is a continuous and ever-changing process. Successful companies constantly make changes to products and processes, collecting new knowledge, which demonstrates the importance of innovation to society. The result is not only a simple numerical improvement in one area, but a geometric progression involving and effecting the outcome of several related areas in a synergistic manner. Clear efficiency gains were observed in the subject company.

Keywords:

Construction companies, Innovation delivery, Technical innovation

Theme:

Sustainability in Built Environment

This page is intentionally left blank

Towards Sustainable Consumption: Enhancing the Use of Reprocessed Construction Materials within the Australian Construction Industry

Gihan Anuradha Tennakoon^{1*}, Raufdeen Rameezdeen¹ and Nicholas Chileshe¹

¹University of South Australia, UniSA STEM, Centre for Sustainable Infrastructure and Resource Management (SIRM), Adelaide, AUSTRALIA

gihan.tennakoon@mymail.unisa.edu.au; rameez.rameezdeen@unisa.edu.au; nicholas.chileshe@unisa.edu.au

* Corresponding author

Abstract:

Despite the ever-growing volumes of demolition waste (DW), extant literature points to a low uptake of reprocessed construction materials (RCMs) derived from DW, thus undermining the success of waste recovery schemes. In an industry driven by economic motives, the lack of demand for RCMs would make resource recovery operations unsustainable in the long run. Moreover, a review of the literature also revealed that there is a narrow focus in existing research on the 'market' aspect of DW recovery operations. Therefore, this study focused on identifying interventions to encourage the uptake of RCMs within the Australian construction industry. Following a qualitative interviewbased research approach, interventions for encouraging the use of RCMs were explored from the perspective of construction industry professionals (CIPs) involved in material selection decisions. The thematic analysis technique was used to analyse the interview data. The study findings revealed sixteen informational and structural interventions for enhancing the use of RCMs, and these interventions were mapped against the industry levels at which they should be implemented. RCM suppliers should focus primarily on improving material quality, supply consistency, and marketing while minimizing material costs. The Government should encourage the use of RCMs through supportive legislation and incentive schemes. The importance of awareness building around RCMs and their potential uses was also highlighted, which requires the collective efforts of RCM suppliers, educational institutes, and governmental and non-governmental bodies. Implementing these interventions would create a positive shift in the demand for RCMs, thereby ensuring the long-term viability of resource recovery schemes.

Keywords:

Australian construction industry, Demolition waste, Market, Reprocessed construction materials

Outsourcing and Insourcing Construction 4.0 Technologies for Sustainability in the Nigerian Construction Industry

Fortune Aigbe^{1*}, Clinton Aigbavboa² and Lekan Amusan¹

¹Department of Building Technology, Covenant University, P.M.B 1023, Ota, Ogun State, NIGERIA ²Department of Construction Management and Quantity Surveying, University of Johannesburg, Maropeng 198, SOUTH AFRICA

> fortune.aigbe@covenantuniversity.edu.ng;caigbavboa@uj.ac.za; lekan.amusan@covenantuniversity.edu.ng

* Corresponding author

Abstract:

The evolution of the Industrial revolution has provided a framework for the Construction industry 4.0. The Nigerian construction industry is yet to fully adopt the technologies of Construction 4.0, as the level of awareness is still very low, and there is a general dearth of skills needed to fully implement these technologies in the industry. Therefore, this study aims at encouraging the insourcing and outsourcing of construction 4.0 technologies to encourage sustainability in the Nigerian construction industry. The methodology used for this study includes mean, rank order, Taro Yamane formula, frequency, tabulation, and percentages. The sampling techniques used for this study was Purposive sampling techniques, while Questionnaire was the Primary source of data collection. The findings show that the construction-specific construction 4.0 technologies are; Prefabrication technology, Building Information Modeling. While the nonconstruction-specific construction 4.0 technologies are; The internet of things, Cloud computing, etc. Among the various factors militating against the adoption of Construction 4.0 adoption are; the high cost of implementation, lack of required skills, and uncertainty. The various technologies to be insourced within the construction industry are; Prefabrication, Building Information Modeling (BIM), while the technologies to be outsourced are; Augmented reality, Artificial intelligence, etc. Insourcing and outsourcing can help in enhancing sustainability in the construction industry by; helping eliminate long-term capacity issues, reducing cost, increasing security, etc. The study recommends that Construction companies should collaborate within themselves and with other non-construction companies to hasten the adoption of these construction 4.0 technologies.

Keywords:

Construction 4.0, Insourcing, Outsourcing, Sustainability, Technology

Barriers and Enablers of the Adoption of Recycled Materials Usage in Asphalt Pavement for the USA and Australia: A Systematic Review

Timothy Cassidy¹, Muhammad Nateque Mahmood^{1*} and Argaw Gurmu¹

¹School of Architecture & Built Environment, Deakin University, 1 Gheringhap Street Geelong VIC 3220, AUSTRALIA

timothy.g.cassidy@gmail.com; n.mahmood@deakin.edu.au; argaw.gurmu@deakin.edu.au * Corresponding author

Abstract:

There is a global push for developing more sustainable infrastructure, including the use of recycled materials in asphalt pavements. It is apparent that using recycled materials offers environmental and economic benefits as it diverts waste materials away from landfills whilst also reducing the need for new virgin aggregates and binders. The initial research identified previous reviews that had focussed on a single material did not investigate barriers or lacked a structured framework. As such, this study sought to address these gaps, with a focus on Australia and the United States. This study conducted a systematic literature review to identify barriers and enablers to the use of recycled materials in asphalt pavements. The initial literature search yielded 425 results. Then, after a screening of article titles and abstracts for relevance, 294 articles were deemed eligible for inclusion in the study. The study found the most prominent recycled material in the existing literature was Reclaimed Asphalt Pavement in both USA and Australia. The barriers identified in the literature were lack of reliable information on performance, lack of mix-design information, inadequate test methods, production issues, impaired rerecyclability, and detrimental effects on workers' health and safety. This study also identified that the known enablers are not yet fully understood and require further research to better overcome barriers. It is expected that regulatory government agencies, civil construction contractors, and asphalt companies will benefit from this research.

Keywords:

Asphalt pavements, Qualitative analysis, Reclaimed Asphalt Pavement (RAP), Recycled materials, Rejuvenators

Estimating the Life Cycle Energy Consumption of Urban Residential Buildings Based on A New System Boundary: An Empirical Study of China

Lei Liu^{1*}, Vivian W.Y. Tam¹, and Khoa N. Le¹

¹School of Engineering Design & Built Environment, Western Sydney University, Locked Bag 1797 Penrith NSW 2751, AUSTRALIA

leiliu.m.chn@gmail.com; vivianwytam@gmail.com; k.le@westernsydney.edu.au * Corresponding author

Abstract:

Building energy consumption, as one of the biggest emitters worldwide, has been an urgent social issue to be solved along with the global abnormal climate occurring frequently. Undoubtedly, accurate estimation is a useful way to help improve energy conservation policymaking and energy services adjusting. Although there is a consensus about the life cycle energy boundary of buildings which is mainly comprised of embodied and operational energies, calculating errors still existed under such system boundary. Certainly, part of the reason comes from methods' limitations, but interestingly, some recent studies suspected the indirect contribution of mobile energy such as occupants' daily commuting and travel on building energy. To fill the gap between estimated and actual energy consumption, this paper proposes an extended life cycle energy system of buildings, which includes embodied, operational, and mobile energies. Then, an empirical study in China is conducted, which adopts a hybrid life cycle assessment method (H-LCA) combined with macro and micro data to estimate the life cycle energy consumption of urban residential buildings from 2005 to 2019. Results show that there was a moderate increase in building energy consumption, but the embodied and operational energy intensities decreased dramatically. Besides, the life cycle energy consumption estimated was higher by about 6.6%-19.6% than that of other studies, and the contribution of mobile energy to total energy consumption increased significantly from 5.49% in 2005 to 23.86% in 2019. Admittedly, this study provides a new energy system idea for the next studies in the field.

Keywords:

Energy consumption estimation, Life cycle energy, Mobile energy, Urban residential buildings

Behavioral Attitudes of Construction Professionals Towards the Industry's Waste Minimization Culture: A Factor Analysis of Key Influential Factors

Benjamin Kwaku Ababio1*, Weisheng Lu1 and Prince Antwi-Afari2

¹Department of Real Estate & Construction, The University of Hong Kong, Pokfulam, HONG KONG ²Department of Civil Engineering, The University of Hong Kong, Pokfulam, HONG KONG

bababio@connect.hku.hk; wilsonlu@hku.hk; pantwiaf@connect.hku.hk * Corresponding author

Abstract:

Addressing the global challenge of construction waste generation has the potential to improve the sustainability and efficiency of the industry. Yet, construction waste minimization (CWM) is poorly practiced across projects in Sub-Saharan Africa, and can be generally linked with awareness, attitude, and behaviour of construction professionals. This study therefore places emphasis on the social aspect of CWM, and aims at examining the behavioural attitudes of professionals towards the industry's waste minimization culture. To achieve the aim of this study, relationships between key influential factors of waste-reduction behaviour of construction professionals are critically evaluated, with focus on Ghana, a developing country in the sub region. Using questionnaire survey based on existing literature and the theory of planned behaviour, factors that influence waste minimization behaviour was obtained from 112 construction professionals and analysed using exploratory factor analysis. The study reveals that intentions and attitudes are strong predictors of pro CWM behaviour, and professionals generally demonstrate a good sense of awareness towards waste minimization culture. However, external factors can create an enabling or disenabling environment for the right waste minimization behaviour. Four main clusters of influential factors are found to be essential to the development of waste minimization culture; industry related factors, team relationships, project specific and cultural factors, and motivational factors. The findings of this research should guide industry stakeholders, especially organization decision makers, to focus on key areas that need to be developed to realize social change and informs construction professionals about the different factors that affect CWM behaviour.

Keywords:

Behavioural attitude, Construction waste minimization (CWM), Factor analysis, Ghana, Professionals

A Decision Support Tool for Designing out Waste in Construction Projects: A Conceptual Framework

Nguyet Tong^{1*}, Niluka Domingo¹ and An Thi Hoai Le¹

¹School of Built Environment, Massey University, Auckland 0632, NEW ZEALAND

nguyetnuce@gmail.com; N.D.Domingo@massey.ac.nz, A.lethihoai@massey.ac.nz * Corresponding author

Abstract:

Construction activities are expected to grow steadily worldwide, leading to creating a massive volume of construction and demolition (C&D) waste. Findings from previous works show that designers' lack of competencies and experience is one of the main causes of C&D waste. Hence, decision support tools can be applied to support designers in implementing designing out waste (DoW). However, existing studies tend to focus on design technologies for waste reduction rather than decision-making support tools to help designers select optimal design solutions for C&D waste minimisation. The primary aim of this study is to develop a conceptual framework for the future development of a DoW decision support tool for designers. The study employs a narrative literature review conducting a critical literature review on design strategies for DoW implementation, C&D waste estimation models, and cost-benefit and environmental impact analysis of both construction and demolition waste to establish a holistic support tool. The tool will be fully engaged in the design process to provide real-time analysis of the waste outcomes for the decision-making process

Keywords:

Construction and demolition waste, Decision support, Designing out waste, Minimisation

Exploring Critical Success Factors for Promoting a Circular Economy in New Zealand Construction

Kam Yuen Cheng^{1*} and Yuwei Xia²

¹Engineering and Architectural Studies Department, Ara Institute of Canterbury, 130 Madras Street, Christchurch, NEW ZEALAND ²William Corporation, Level 4/2 Cathedral Square, Christchurch Central City, Christchurch 8011, NEW ZEALAND

kam.cheng@ara.ac.nz; ywxia555@outlook.com

* Corresponding author

Abstract:

The circular economy (CE) focuses on a restorative and regenerative economy by designing and keeping resources, components, and materials at their highest utility and value. Scholars worldwide have brought up this concept and emphasised it in the construction industry. Though precedent studies have shown the environmental benefits of the CE approach in the construction industry, circular buildings are still rare. New Zealand practitioners face profound challenges in integrating circular economy principles into construction projects. This research aims to investigate the critical success factors (CSFs) for implementing a circular economy in New Zealand's construction industry. This research comprises a focused literature review, questionnaire survey of industry practitioners and factor analysis, followed by a conclusion. The Relative Importance Index (RII) will be used to scale the ranking of those factors. A total of 20 factors impacting the adoption of a circular economy in NZ's built environment have been identified and categorised into four categories: Design Inputs, Organisational Strategies, Information Management and Governmental Support. The identified factors are scaled and prioritised by industry experts and practitioners. The outcome of this research shows that Awareness of circular economy, Reuse and recycling, Engagement of standard components from upstream players and Collaborative working and engagement with every stakeholder sit at the top four positions. Therefore, it would provide practical guidance to the construction industry practitioners in New Zealand.

Keywords:

Circular economy, Construction, Offsite construction, Sustainability, Success factors

A Review of Residential Construction Waste Reduction

Hadeel Albsoul ^{1*}, Dat Tien Doan ¹, Itohan Esther Aigwi¹ and Ali GhaffarianHoseini ¹

¹School of Future Environments, Auckland University of Technology, WZ Building, 34 St Paul Street, Auckland 1010, NEW ZEALAND

 $hadeel.albsoul@autuni.ac.nz; \ dat.doan@aut.ac.nz; \ esther.aigwi@aut.ac.nz, \\ ali.ghaffarianhoseini@aut.ac.nz \\$

* Corresponding author

Abstract:

The residential construction sector in New Zealand and worldwide is experiencing increased criticism about generating substantial waste that can cause significant environmental concerns. Accordingly, construction waste (CW) reduction strategies have been widely encouraged by researchers as a sustainable solution to managing CW. This paper provides a comprehensive overview of residential CW reduction (RCWR) concepts using keyword mapping analysis. The key objective of this paper is to understand the concepts of RCWR. Around 87 articles were extracted from the Scopus database and analysed using the VOSviewer software. Co-occurrence analysis of keywords resulted in three main themes for RCWR concepts: (1) CW estimation; (2) Environmental assessment based on the two primary concepts of environmental benefit and impact; (3) Design decisions for RCWR. The results indicate that informed design decisions regarding methods and building materials is the most critical concept acknowledged by researchers for effective RCWR. Furthermore, future research areas highlighted the need to explore the contribution of energy-efficient building materials to RCWR. These results provide valuable information to support RCWR's future policy formulation and deeper insights into research direction.

Keywords:

Construction waste, Residential construction, Keyword mapping, Waste reduction

Challenges to Zero Carbon Refurbishment of Existing Buildings in New Zealand: An Exploratory Study

Thao Thi Phuong Bui^{1*} Niluka Domingo¹ Suzanne Wilkinson¹ and Casimir MacGregor²

¹School of Built Environment, Massey University, Auckland, 0632, New Zealand ²Building Research Association of New Zealand, Judgeford, Porirua, 5240, NEW ZEALAND

T.Bui@massey.ac.nz; N.D.Domingo@massey.ac.nz; casimir.macgregor@branz.co.nz; S.Wilkinson@massey.ac.nz

* Corresponding author

Abstract:

The construction sector has a key part to play in alleviating climate change and achieving net-zero greenhouse gas (GHG) emissions by 2050. Building refurbishment is crucial as the majority of the existing building stock will still be in use in 2050. Over the past two decades, studies on zero carbon refurbishment have provided important technical information but given little attention to other aspects, such as the current industry practices on carbon-reduction refurbishment and building stakeholders' decision-making on reducing carbon emissions in refurbishment projects. In response to this important issue, we investigate opportunities and challenges in reducing carbon emissions in the refurbishment process by undertaking an exploratory study using seventeen semistructured interviews with construction experts within Aotearoa New Zealand. Even though refurbishing existing buildings presents a significant opportunity to reduce embodied carbon emissions by reusing existing buildings' components, it must still carefully consider embodied carbon emissions of newly-added construction materials and products. Our research indicates several challenges to reducing carbon emissions in the refurbishment process, including (1) inexplicit carbon goal setting, (2) ineffective building condition assessment, (3) deficient and incomprehensive relevant whole-of-life carbon information to support the decision-making, and (4) inconsistent and ambiguous carbon-calculation guidelines and benchmark. A comprehensive decision support framework incorporating carbon-reduction initiatives for building refurbishment is suggested for future work. This research contributes to theoretical and practical knowledge by providing recommendations to enhance industry practices in reducing whole-of-life carbon emissions for building refurbishment.

Keywords:

Carbon emissions, Carbon reduction, Existing building, Refurbishment, Zero carbon

Incentivization of Sustainable Waste Management Solutions for Commercial Construction in Australia

Pieter van der Lans^{1*}, Christopher Jensen¹ and Mehran Oraee¹

¹ Faculty of Architecture, Building and Planning, The University of Melbourne, Parkville, VIC 3010, Australia

pvanderlans@student.unimelb.edu.au; cjensen@unimelb.edu.au; mehran.oraee@unimelb.edu.au * Corresponding author

Abstract:

The construction industry has one of the highest waste intensities in Australia. While currently there are barriers to the implementation of sustainable waste management (WM) practices, there is a lack of viable solutions to overcome these barriers. This research aims at examining the main barriers and issues to the implementation of sustainable WM in the Australian commercial construction industry with a focus on incentivization as a possible solution. To this end, a qualitative approach through interviewing experts in the field is adopted to explore new ideas around possible solutions to the issue. Thus, 13 online semi-structured interviews were conducted with experts in the Australian construction industry and the findings show that participants are willing to use more sustainable WM practices, however, the barriers are too substantial. The findings also indicate solutions such as influencing WM practices by stakeholders (client, government, and industry regulators) through financial incentives, mandating measurable and relevant KPIs, amending existing legislations, implementing stewardship programs, conducting audits on waste contractors to improve the waste reporting reliability, and creating separate waste streams to foster a Circular Economy. This study benefits researchers and practitioners by shifting their focus more towards solutions around the incentivization of head contractors (HC) towards sustainable WM practices.

Keywords:

Construction, Incentivization, Resource recovery, Sustainable, Waste management

Revealing the Value of the Circular Economy as a Solution for Mitigating Waste Implications Within the Construction Industry

Nathan Johns^{1*}, Saeed Talebi¹, David Edwards¹, Chris Roberts¹ and Mark Shelborne¹

¹ School of Engineering & Built Environment, Birmingham City University, Millennium Point, Curzon Street, Birmingham, B4 7XG, UNITED KINGDOM

Nathan.Johns@BCU.ac.uk; Saeed.Talebi@BCU.ac.uk; David.Edwards@BCU.ac.uk; Chris.Roberts@BCU.ac.uk; Mark.Shelborne@BCU.ac.uk

* Corresponding author

Abstract:

This paper critically reviews the inherent value of the circular economy (CE) as a systems solution framework for mitigating anthropogenic pollution associated with linear consumption and waste within the construction industry. Although the CE has been identified as a key innovation for mitigating the concomitant environmental implications of consumption and waste, within construction activities, it requires further development and application for widescale application. Such development is currently hindered by the industry's failure to collect pertinent practical data on the inherent value of the CE strategy within the sector. Therefore, to achieve the next stage of development, the inherent value of the CE must be explicitly elucidated upon to incentivise industry application. To explore this phenomenon, a review of core literature and government documents on CE applications in the construction industry were undertaken. The research findings revealed that stakeholders within the industry (e.g., the client, designers and contractors) have a lack of knowledge of the innate value of the CE strategy. This paper's contribution to knowledge is threefold viz .: (i) it identifies the value driving the CE within the construction industry as a solution to consumption and waste; (ii) it analyses the barriers to wider CE implementation and provides insight into the reasons hindering CE development, and (iii) it provides researchers and practitioners with a pivotal basis for the development of the CE. Future research elucidated upon includes informing and incentivising construction industry stakeholders to gain further practical data collection on the value of the CE strategy within construction.

Keywords:

Circular economy, Closed-loop, Construction industry, Environmental implications, Value

Opportunities for Energy Efficiency Using Biomimicry Strategies in the Construction Industry

Nicholas Donohoe¹ Alan Todhunter¹ and Laura Almeida^{1*}

¹School of Engineering Design & Built Environment, Western Sydney University, Locked Bag 1797 Penrith NSW 2751, AUSTRALIA

19339030@student.westernsydney.edu.au; a.todhunter@westernsydney.edu.au; l.almeida@westernsydney.edu.au

* Corresponding author

Abstract:

Biomimicry studies the mimicked solutions of natural structures, processes, or systems that have evolved over time. It is seen as an alternative solution to sustainability issues concerning the built environment. This paper summarises a study performed, by analysing the opportunities for implementing biomimicry, also known as biomimetics, in the construction sector as a reliable solution to promote energy efficiency in buildings. The methodology adopted was a narrative literature review performed in a structured manner. Prior to the methodology a general literature review was completed to identify and describe key components of the research which developed a structure for the paper to adhere to. Following the methodology, a qualitative analysis of existing examples of the implementation of biomimicry in the built environment was argued against the increased energy efficiency. Results have shown that biomimicry is a reliable alternative to reducing energy usage in buildings. Additionally, the combination of biomimetic principles within multiple elements of the building increases the effectiveness of the overall strategy. Most of the studies examples show that the standard implementation of biomimetic solutions is within the façade, structure, or HVAC system. Results also show that significant energy savings resulted from a behavioural or eco-system level of biomimicry, where the building mimics the process or function of a natural structure, system, or process. Due to its recent recognition as a science and alternative architectural solution, biomimicry is yet to be seen as an emerging sustainable strategy.

Keywords:

Biomimetics, Biomimicry, Construction, Energy efficiency, Sustainability

A Conceptual Framework for Carbon Trading in the Construction Industry

Augustine Senanu Komla Kukah^{1*}, Xiaohua Jin¹, Robert Osei-Kyei¹ and Srinath Perera¹

¹School of Engineering Design & Built Environment, Western Sydney University, Locked Bag 1797 Penrith NSW 2751, AUSTRALIA

19916688@student.westernsydney.edu.au*; xiaohua.jin@westernsydney.edu.au; r.osei-kyei@westernsydney.edu.au; srinath.perera@westernsydney.edu.au; * Corresponding author

Abstract:

The need to control and reduce greenhouse gases has become urgent throughout the world. Emissions trading has been established to be a reasonable panacea in curbing future levels of emissions. Carbon trading systems were originally not designed for the construction industry and has little application in the construction sectors. The overall aim of this ongoing study is to develop a construction tailored carbon trading system. However, this paper presents on the first stage which is the development of a conceptual framework for carbon trading in the construction industry. Systematic literature review methodology was adopted to obtain documents from Scopus which were then synthesised. From the findings, the major constructs comprising the conceptual framework are construction market, construction plan, construction strategies and construction policies. This framework aids the construction industry in its climate change mitigation and further proposes to develop trading system unique to the features of the construction industry.

Keywords:

Carbon trading, Conceptual framework, Construction industry, Greenhouse gases

Estimation of Construction and Demolition Waste using Meta-Analysis

Ali Alashwal^{1*} and Awornit Shrestha¹

¹School of Engineering Design & Built Environment, Western Sydney University, Locked Bag 1797 Penrith NSW 2751, AUSTRALIA

a.al-ashwal@westernsydney.edu.au

* Corresponding author

Abstract:

Construction and demolition waste estimation help to make important decisions during project planning and execution. For instance, contractors need to estimate the cost of the waste levy, determine waste material types and methods of hauling waste off-site, and other logistics. Waste estimation provides a benchmark to compare the actual waste generated during construction. This topic has attracted many researchers who have provided estimates of construction and demolition waste using various estimation methods. However, there is still no unified value of the waste amount to generate new estimates. The purpose of this paper is to benefit from the many studies available in the literature and use meta-analysis to synthesise and analyse previous estimates and develop a new estimate for construction building projects. Based on the analysis of 26 papers, the results of the analysis revealed a mean value of 41.31 kg per square meter of gross floor area for residential and non-residential projects (standard deviation = 21.89 kg per square meter). This result is useful to aid contractors and project managers to predict construction and demolition waste amounts and develop waste management plans

Keywords:

Construction waste management, Meta-analysis, Waste estimation, Waste prediction

Developing an Assessment System on Green Construction Sites in Australia

Xiancun Hu^{1*}, Sarah Elattar¹, Aifang Wei¹ and Charles Lemckert²

 ¹School of Design and the Built Environment, University of Canberra, 11 Kirinari St Bruce ACT 2601, AUSTRALIA
 ²Faculty of Science and Engineering, Sothern Cross University, Military Road, East Lismore NSW 2480, AUSTRALIA

larry.hu@canberra.edu.au; sarah.elattar@canberra.edu.au; amy.wei@canberra.edu.au; charles.lemckert@scu.edu.au

* Corresponding author

Abstract:

Around the world, there are many assessment systems for green building, such as the LEED system in America and the BREEAM system in the U.K. In Australia, the Green Star rating system is widely considered the standard for assessing healthy, resilient, positive buildings and places. However, these assessment systems are generally limited to new buildings from life-cycle viewpoints, and are less focused on environmental sustainability assessment at construction sites. Moreover, few countries have published green assessment systems for construction projects. How to assess and improve the environmental sustainability of projects during the on-site construction stage plays an important role in enhancing the sustainable performance of construction companies and products. This study will develop an assessment framework for rating green construction projects during the on-site stage. An extensive literature review was first conducted to develop the framework based on identifying the relevant system and indicators of green construction practices. The developed framework will be further tested and improved through the Expert Evaluation method. Therefore, the framework could be used to assess green construction practices and provide education resources for construction managers, engineers, academics, students and workers to improve their awareness and abilities in promoting green construction in Australia.

Keywords:

Assessment, Australia, Construction site, Environmental performance, Green construction

Theme:

Resilience in Built Environment

The Adaptation of the Facility Condition Index (FCI) in the Australian Tertiary Education Sectors Management of a Building Portfolio

Jye West^{1*}, Milind Siddhpura¹, Ana Evangelista¹ and Assed Haddad²

¹Engineering Institute of Technology, 1031 Wellington St, West Perth, WA 6005, AUSTRALIA ²Programa de Engenharia Ambiental, Universidade Federal do Rio de Janeiro, Rio de Janeiro 21941-901, BRAZIL

1064170@student.eit.edu.au; Milind.siddhpura@eit.edu.au; ana.evangelista@eit.edu.au; assed@poli.ufrj.br

* Corresponding author

Abstract:

The asset value of a typical university portfolio is in the billions of dollars as specialised facilities, laboratories, and architecturally designed structures dominate the portfolio landscape. The annual expenditure to service and maintain these assets continue to be scrutinised as the cost to service and maintain these structures are constantly being reviewed and assessed against rising inflation, and the ever-increasing costs of utilities and the associated infrastructure. Over the years, different methodologies to determine an accurate Facility Condition Index (FCI) were and continue to be adopted as estate management strives to be nimble, agile, and flexible as their portfolios increase in size, reduce in allocated funding, and continue to age and approach the end of their economic lifecycles. Utilising frequently used information from the Asset Replacement Valuations (ARV), combined with asset field data from the Facility Condition Assessments (FCA) different calculation methodologies are discussed to evaluate their level of reporting accuracy. Furthermore, this paper discusses the comparative results of architecturally upgrading a building asset, yet the investment appears to have limited impact on reducing backlog, statutory and non-statutory maintenance requirements. Similar to other industries, a cost effective, transparent and reliable evaluation methodology of determining a buildings Facility Condition Index (FCI) is becoming increasingly important to determine the level of risk and liabilities (some hidden) when valuing a multi-million dollar building asset during an acquisition, equity or insurance evaluation process.

Keywords:

Facility Condition Index, Governance, Stakeholder Management, Strategic Asset Management

Climate Change Impact on Cooling and Heating Demand of Buildings in Penrith

Mohammadreza Khanarmuei¹, Keivan Bamdad^{1*} and Srinath Perera¹

¹School of Engineering, Design and Built Environment, Western Sydney University, AUSTRALIA

> r.khanarmuei@westernsydney.edu.au; k.bamdad@westernsydney.edu.au; srinath.perera@westernsydney.edu.au

* Corresponding author

Abstract:

On January 4, 2020, Penrith was the hottest place on Earth. According to the Intergovernmental Panel on Climate Change (IPCC), extreme weather conditions will become more severe in the future, which not only increases cooling energy demands but also poses threats to the health of occupants in buildings. Therefore, improving the thermal performance of buildings is critical to enhancing occupants' thermal comfort and mitigating climate change. Accordingly, this research aims to quantify the climate change impacts on the cooling and heating demands of buildings in Penrith, Australia. Heating and Cooling Degree days (HDDs and CDDs) methods are used to predict the cooling and heating demands under present and future climate conditions. It is predicted that Penrith would experience up to a 5.1°C temperature increase by 2100 under the high emission scenario. It is estimated that CDDs would increase approximately from 900 to 1400 by 2100 under the SSP2-4.5 emission scenario. This increase could roughly reach up to 2500 under the SSP5-8.5 emission scenario. In contrast, HDDs are expected to decline approximately from 630 to below 100 under the high (SSP5-8.5) emission scenario by the end of this century. It is expected that the findings of this research can be used as a guideline for architects and building designers to improve the energy performance of buildings in one of the fastest growing cities in Australia.

Keywords:

Building energy demand, Climate change, Cooling degree days, Heating degree days, Shared Socioeconomic Pathways

An A-Priori Framework for Community Transformation through Inclusive Risk-Sensitive Urban Development

Devindi Geekiyanage^{1*}, Terrence Fernando¹ and Kaushal Keraminiyage¹

¹THINKlab, School of Science, Engineering and Environment, The University of Salford, Maxwell Building, 43 Crescent, M5 4WT, UNITED KINGDOM

m.d.hembageekiyanage@edu.salford.ac.uk; t.fernando@salford.ac.uk; k.p.keraminiyage@salford.ac.uk * Corresponding author

Abstract:

Community-inclusive decision-making in developing equitable and risk-sensitive developments, particularly in urban settings, is becoming trending for achieving sustainable development goals (particularly SDG 10 and 11) set by the United Nations in 2015. A long-standing challenge in community-inclusive, equitable and risk-sensitive urban development has been to anchor practice and continuous evaluation in a relevant and comprehensive theoretical framework of community change. This study describes the development of a multidimensional theoretical framework that builds on the prevailing community/social change models and theories to identify key components of community transformation processes through civic engagement 3.0. An 'A-Priori framework' was developed adopting the "Best-fit" framework synthesis approach following a slightly adapted version of the BeHEMoTh search strategy for literature selection. The systematic review resulted in 46 publications where only 12 publications containing 09 models that provide theoretical underpinnings for community change were included in the study. The study identified 12 key constructs to be integrated into a community transformation model for participatory development. They are; the context, phases of transformation, change triggers, lead agency and institutional collaboration, change process, implementation, resources, cognitive factor, behaviour factors, environmental factors, change, and assessment and evaluation towards inclusive cities. The theoretical framework presented will be of use for industry practitioners, voluntary organisations and academicians in developing a conceptual framework by referring to empirical literature and data, and thereby establishing relationships among constructs to generate a meaningful model for mobilising communities through community engagement.

Keywords:

Civic engagement 3.0, Community transformation, Framework synthesis, Risk-sensitive urban development, SDG 11

Overview of New Zealand legislation for Flood Resilience

Widi Auliagisni^{1*}, Suzanne Wilkinson¹ and Mohamed Elkharboutly¹

¹School of Built Environment, Massey University, Massey University Private Bag 102904, North Shore Auckland 0745, NEW ZEALAND

w.auliagisni@massey.ac.nz; s.wilkinson@massey.ac.nz; m.elkharboutly@massey.ac.nz * Corresponding author

Abstract:

Floods affect more people than any other hazard in the world and are also a hindrance to countries meeting their Sustainable Development Goals. A shift from traditional flood protection action to a more risk-aware and resilient approach is required especially in protecting communities at risk from the recurring flood. In New Zealand, the shift can be encouraged by the legal system, such as policy development for national flood management or local catchment management activities. The challenges of climate change, however, could exacerbate the existing flood risk, change flood management priorities, and create uncertainty. The New Zealand government prompted to consider whether flood protection in the country is sustainable for now and for the foreseeable future, especially at the local level. A literature analysis study is used, and the reviewed documents include media, government documents, non-governmental organisations' documents, academic journals, best practices, and local law. Drawing from the analysis of flood-related documents and legislation this research found that the existing legislative framework provides the policies and implementation tools for regional councils to better manage the flood risk. Additionally, through the best practices of local law implementation, this study provides some recommendations for an effective legal framework that will facilitate sustainable flood management and flood resilience.

Keywords:

Flood resilience, Literature analysis, Local law, Sustainable flood management

Comparative Response Spectrum Analysis on 15 Storey Reinforced Concrete Buildings Having Shear Walls with and without Openings as per EN1998-1 Seismic Code

Mistreselasie S. Abate^{1*}, Ana Catarina Jorge Evangelista¹ and Vivian W.Y. Tam²

¹Engineering Institute of Technology, 1031 Wellington St, West Perth, WA 6005, AUSTRALIA

²School of Engineering Design & Built Environment, Western Sydney University, Locked Bag 1797 Penrith NSW 2751, AUSTRALIA

12536@student.eit.edu.au; ana.evangelista@eit.edu.au; v.tam@westernsydney.edu.au * Corresponding author

Abstract:

In Ethiopia's major cities, medium-rise Reinforced Concrete (RC) framed apartment complexes with stories ranging from 4 to 15 are becoming more popular. Shear walls are supplied for lateral load resistance in medium-rise RC framed structures. Because apertures are often supplied in shear walls, it is vital to investigate their impact on storey drift, storey stiffness, shear and moments, and stress inside the shear walls. For the examination of the effect of openings in a building's shear wall, a 3-D analysis is performed. The consequences of the size and position of these apertures are examined in this research. On the basis of this investigation, detailed data have been gathered, and helpful conclusions have been reached that will be of service to practicing engineers. The seismic parameter for RS analysis was used Building Code of Ethiopia ES8-15 corresponds to Eurocode 8-2004 standards (based on EN1998-1) seismic code recommendations with target response spectrum parameter Ground Acceleration, ag/g=0.1, Spectrum Type=I, Ground Type=B, Soil Factor, S=1.35, Spectrum Period, Tb, =0.05 sec, Spectrum, Tc= 0.25 sec, Spectrum Period, Td=1.2 sec, Lower Bound Factor, Beta=0.2, Behaviour Factor=1, and Damping ratio =5% was used. The results are compared based on different parameters such as Displacement, Storey Drift, Base Shear, Storey Shear, and Storey Moment for both with and without shear wall opening case. This study will give tremendous insight on the effect of shear wall openings on the performance of the structure. In this study the analysis was performed on linear model which might not capture the full local response of the structure; hence it is highly advisable for future researchers to perform nonlinear analysis based on performancebased design. From this paper we concluded that the performance of the structure greatly improved by introducing shear wall than that of framed structures. Shear wall openings provided in a structure tremendously impact the performance of the building. For seismic hazard areas, it is highly recommended to use shear wall structure due to its high resistivity to the earthquake forces.

Keywords:

Response Spectrum, Storey Displacement, Storey Drift, Storey Moment, and Storey Shear

Resilience of Post-Resource Landscapes

Sarvin Elahi¹*, Penny Allan¹ and James Melsom¹

¹Faculty of Design, Architecture and Building, University of Technology Sydney 15 Broadway, Ultimo NSW 2007, AUSTRALIA

sarvin.elahi@student.uts.edu.au; penny.allan@uts.edu.au; james.melsom@uts.edu.au * Corresponding author

Abstract:

This research investigates the resilience of post-resource landscapes with a focus on Broken Hill in NSW. Extraction practices have made these landscapes and the communities who live there vulnerable, and more so in the face of major disturbances such as land degradation, drought and water scarcity, loss of native vegetation cover, contamination of natural resources, climate change, political disturbance, and social disorganisation. Because individual responses to each social-ecological hazard are not adequate or within the scope of local infrastructure, broader resilience during everyday life becomes critical to effective adaptations in the face of evolving risks. Although rehabilitation of post-resource landscapes is typically considered independently of local communities, the research considers how a coupled system of social networks, inextricably interwoven with landscape renewal can strengthen the collective capacity of a city. This research undertakes a comparative analysis of two sites, Broken Hill in NSW, Australia, and Sarcheshmeh Copper city in Kerman Province, Iran, where mining activities have caused industry-related environmental pollution, a reduction in the capacity of the land, and an increase in the vulnerability of local communities. The research illustrates how the adaptation of existing infrastructures and the integration of regional interspecies logics that have proven their capacity to withstand and recover from hazards can offer a broader, regenerative ecological and social infrastructure, as well as a culture of knowledge and care for land. Developing collective capacities in this way can strengthen everyday activity, which makes both communities and landscapes more resilient while enhancing adaptation potentials to cope better with the sudden and unpredictable shocks.

Keywords:

Urban resilience, Social-ecological system, Everyday resilience, Post-mining landscapes

Evolutionary Designed Building Skins with Embedded Biomimetic Adaptation Lessons

Saam Kaviani^{1*}, Yamuna Kaluarachchi², Federico Rossi¹ and George Ofori¹

¹School of Architecture & Built Environment, London South Bank University, 103 Borough Rd, London, SE1 0AA, UK
²Manchester School of Architecture, Manchester Metropolitan University, Chatham Building, Cavendish St, Manchester M15 6BR, UK

kavianis@lsbu.ac.uk*; y.kaluarachchi@mmu.ac.uk; federico.rossi@lsbu.ac.uk; oforig3@lsbu.ac.uk * Corresponding author

Abstract:

The ambition of this study is to create a computational design engine that develops testable simulated models that can adapt to various situations or environments by abstracting some adoption lessons from biology and their relationship to the evolutionary growth of natural systems. With an emphasis on the optimisation of thermal and visual comfort across specific floor areas, the abstracted principles of biology are used to develop building skin tissues. These designs, evaluations, and implementation principles are conceptualised and computationally simulated. The idea of nature as a repository of interconnected dynamic processes that are open to investigation and simulation has changed from a formal metaphor to credible applications that can be implemented to improve the built environment. Environmental catastrophes during the past 20 years have accelerated efforts to gain a deeper understanding of natural systems and processes. A greater congruence between architecture and nature is believed to be possible with the help of applying the principles of natural systems and processes to the construction of buildings. Examining and reflecting on the interrelations of forms, processes, and behaviours can yield useful strategies to develop architectural morphologies that require significant environmental performance enhancements. This paper aims to propose an evolutionary design process with embedded biomimetic principles to generate building skins with morphological characteristics that can be applied in the context of excessive solar radiation e.g. the Persian Gulf region, to maximise thermal comfort by blocking unwanted the solar radiation while simultaneously increasing the visual comfort by increasing the view of the users to the outside.

Keywords:

Adaptation, Architecture, Biomimicry, Building Skin, Evolutionary Computation

Unrecognised Ramifications of Base Isolators in Buildings

Ronwyn Coulson¹, Eric Scheepbouwer^{1*} and Daniel Van Der Walt¹

Department of Civil and Natural Resources Engineering, University of Canterbury, Private Bag 4800 Christchurch 8140, NEW ZEALAND

ronwyn.coulson@pg.canterbury.ac.nz; eric.scheepbouwer@canterbury.ac.nz; daniel.vanderwalt@canterbury.ac.nz

* Corresponding author

Abstract:

Base Isolation is a proven method for safeguarding people and property in an earthquake event. It has been used in some rudimentary form or other for over a century and with its modern steel plate and rubber bearing form for over 40 years. While the technology is well understood by earthquake engineers, base-isolated buildings are designed by multidisciplinary teams, and owned, operated, and maintained by stakeholders who are not typically trained in earthquake engineering. The aim of this research was to identify the consequences of base isolation on the overall building from a lifecycle perspective and test whether current design practice (and legislation) provides for safety for the whole design life of a building. Through an integrative literature review of international academic research and base isolator manufacturer literature, New Zealand engineering guidance notes and building legislation, this research highlighted key risks and issues that need to be considered and accommodated by Architects, Engineers, Contractors, and Building Owners when a base-isolated solution is proposed. Risks discovered included the broader implications of displacement, pounding of adjacent buildings, soft-soil and near-fault earthquake sensitivity, base isolator failure (both temporary and permanent), construction safety prior to the release of isolators, durability concerns, and spatial provision for access for regular inspections and replacement during the design life of the building.

Keywords:

Architecture, Asset Management, Base Isolation, Construction, Services Engineering

Inefficient Regulations that Worsen the Housing Crisis

Christian van der Pump^{1*} and Eric Scheepbouwer¹

¹Department of Civil and Natural Resources, University of Canterbury, Private Bag 4800, Christchurch 8140, NEW ZEALAND

christian.vanderpump@pg.canterbury.ac.nz; eric.scheepbouwer@canterbury.ac.nz * Corresponding author

Abstract:

Performance-based design (PBD) has been available in Australia and New Zealand's building legislation for over 25 years. A central feature of PBD has been the availability of horizontal spread of fire (HSF) PBD solutions to address spread of fire between buildings and to other property, whereby fire protection engineers could adopt more efficient solutions than under previous prescriptive rules. However, both countries adopt different regulatory approaches to HSF. For example, in New Zealand, 'other property' is defined as property under a different legal title, whereas in Australia 'other property' can include property under the same title. Moreover, and as this paper argues, neither countries' approach is consistent with the common law approach the courts adopt to address HSF, nor the economic theory where HSF that affects third parties is a negative externality. This paper reviews the economic efficiency of each country's existing HSF PBD regulations. It then argues Coasean bargaining has the potential as a more efficient solution to HSF, increase land utilization, and therefore assist in alleviating the housing crisis.

Keywords:

Coase Theorem, Horizontal Spread of Fire, National Construction Code, New Zealand Building Code

Contractor Bankruptcies in the Australian Construction Industry: Causes and Impacts

Matt Stevens^{1*} and Awais Piracha¹

¹Western Sydney University, Locked Bag 1797 Penrith NSW 2751, AUSTRALIA

 $Matt. Stevens@westernsydney.edu.au; A.Piracha@westernsydney.edu.au \\ * Corresponding author$

Abstract:

The construction industry has one of the highest rates of organisational bankruptcy in Australia. Recently, several building firms have sought legal protection from creditors. This paper examines the impacts of construction company failures, including the economic and societal costs. Several studies conclude that entrepreneurs who suffer from business liquidation have an elevated rate of personal problems than the general population. Additionally, these bankruptcies have significant effects on their families and communities. In the long term, a robust construction industry is required to meet the construction needs of rapid urbanisation and climate-change-related repair and expand the built environment. A better understanding of construction organisations' strategic and operational dynamics should lead to effective initiatives and create a less arbitrary and capricious system that currently causes unnecessary contractor insolvencies. This paper argues that Australia has not paid enough attention to the problem of declining construction capacity despite the predicted fast-growing demand for construction from rapid urbanisation and climate change.

Keywords:

Business default, Company liquidation, Corporate foreclosure, Project failure, Socio-economic harm

A Tale of Two Projects

Robert Mulligan^{1*}, Regan Potangaroa^{1*} and Suzanne Wilkinson^{1*}

¹School of Built Environment, Massey University, Albany, Auckland 0632, NEW ZEALAND

r.mulligan@massey.ac.nz; r.potangaroa@massey.ac.nz; s.wilkinson@massey.ac.nz * Corresponding author

Abstract:

The New Zealand construction sector faces a challenge delivering on the proposed pipeline of work emerging from 2020 onwards, a situation exacerbated by post-Covid-19 recovery funding initiatives. A smart system is needed to enable shared understanding of horizontal and vertical infrastructure planning and delivery, and the sector's ability to deliver. It focuses on resilience, particularly with regard to systemic shocks and stresses on the construction sector arising from Covid. Two case study projects, designed as complex building typologies, represent political aspirations for achieving sustainability goals and industrial revolution. New Dunedin Hospital, estimated to cost \$1.4 billion, is New Zealand's largest healthcare facility and first digital hospital. The Living Pā project, estimated to cost \$75 million, redevelops the marae precinct and Te Tumu Herenga Waka wharenui, at Victoria University of Wellington. The vision is to transform how to realise cultural values, drawing together Mātauranga Māori and sustainability in accord with Living Building Challenge Principles. This paper considers the economic focus (Covid recovery grants and their use); social focus (how Covid has affected the workforce, immigration, resources and changes to work patterns): organizational (how Covid has affected organizations/ changes made): supply chain (as above, plus reliance on alternative products): political (legislation changes and their impact, links to Government policies, guidelines and how they have been used): technological (how Covid has changed technological uses in construction). And will address the issues and how the construction sector in New Zealand responded. Research is limited to an initial literature review and qualitative data from interviews.

Keywords:

CanConstructNZ, Capacity, Capability, Infrastructural, Pipeline, Resilience

Theme:

Health and Safety in Construction

Modelling Stressor Interconnectivities and Mental Wellbeing Among Construction Workers

Imriyas Kamardeen^{1*}, Abid Hasan¹ and Anthony Mills¹

¹School of Architecture and Built Environment, Deakin University, Locked Bag 20001, Geelong Waterfront Campus, Geelong VIC 3220, AUSTRALIA

imriyas.kamardeen@deakin.edu.au; abid.hasan@deakin.edu.au; anthony.mills@deakin.edu.au * Corresponding author

Abstract:

Recent research claims that construction workers endure poor mental health globally, which causes diminished work ability and quality of life for workers and productivity and profit losses for construction organisations. This study aims to understand the work stressors facing construction workers and their relationship with workers' mental health. A systematic literature review approach was adopted in which 35 journal articles published between 2010 and 2021 (inclusive) were examined. Findings suggest that construction workers suffer poor mental health because of encountering numerous stressors at work, with complex interconnections among themselves. It is not plausible to assume a linear cause-and-effect relationship between stressors and the mental health of construction workers. Hence, a new model of work stress is proposed to provide a holistic picture of reality. The model postulates some primary or root stressors that cause significant psychological damage to the workforce. These are long workday/week, masculine culture, productivity-based pay system, short-term and contract-based jobs, inadequate management of cultural disparities among workers and unsafe worksites. Similarly, apprentices, females and young workers are more susceptible to mental stressors and psychological disorders. Workplace injuries and illnesses have a domino effect on the mental well-being of construction workers. Therefore, improving the physical safety on site can partly improve workers' psychological well-being. The study offers valuable practical insights for construction organisations and occupational health and safety authorities to guide the development of effective interventions to mitigate poor mental health in the construction workforce.

Keywords:

Cognitive map, Construction workers, Mental health, Systematic literature review, Work stressors.

Scientometric Analysis and Review of Safety in Design in AEC Industry

Weifang Shi^{1,3}, Alice Chang-Richards¹ and Brian H.W. Guo²

¹Civil and Environment Engineering department, University of Auckland, 20 Symonds Street, Auckland-1010 New Zealand. ²Civil & Natural Resources Engineering, University of Canterbury, Christchurch-8140, New Zealand ³Civil & Architecture Department, Zhongyuan University of Technology,41 Zhongyuan Road, Zhengzhou-450007, P.R. China

wshi306@aucklanduni.ac.nz; brian.guo@canterbury.ac.nz; yan.chang@auckland.ac.nz * Corresponding author

Abstract:

Safety in design (SiD), is a new paradigm for managing workers safety in architecture, engineering, and construction (AEC) sector. However, there is a lack of a holistic mapping on the SiD research in a global range. To explore the advancement and sketch the panorama of SiD research, this research investigates SiD research through a scientometric review. A total of 199 bibliographic records from Web of Science, Scopus, and Engineering Village were retrieved and analysed.

Results show that the most distinguished countries where SiD research have been undertaken are the USA, UK, and China. Major studies fields concentrated on engineering and technology; however, studies on electrical, ergonomics, building information modelling, decision making, equipment, and education are emerging. In addition, the paper presents a framework genialised from several key themes, revealing the focal points and trends of SiD research over time. This review provides a comprehensive understanding of SiD research word wide, contributing to the existing knowledge in safe design and has laid a solid foundation for future research that look into the detailed design features for improving SiD implementation in the construction projects.

Keywords:

Architecture, Engineering, Construction (AEC) sector, Safety in design, Scientometric review.

Recent National Construction Code Changes, Reduced Innovation, and Increased Contractual Risks

Christian van der Pump*1 and Eric Scheepbouwer1

¹ Department of Civil and Natural Resources, University of Canterbury, Private Bag 4800, Christchurch 8140, NEW ZEALAND

christian.vanderpump@pg.canterbury.ac.nz; eric.scheepbouwer@canterbury.ac.nz * Corresponding author

Abstract:

A new clause recently added to the National Construction Code (A2.2(4)) has fundamentally changed the way performance-based design is developed. Previously, designers could formulate a design that was compliant as long as the applicable performance clauses of the National Construction Code were met. This freedom of design allowed designers to compete freely on innovation grounds as opposed to solely on price. However, on 1 July 2021, the new clause regulated this performance-based design process. Designers can no longer formulate a design that complies with the performance clauses. Now, designers must complete a performance-based design brief to be disclosed and approved by multiple parties, many of whom do not have an approval's role, contractual role, or suitable expertise. This process can represent a significant financial risk to developers since assumptions about how land may be built at the development approval stage may be inefficient if some parties do not agree to the performance-based design methodology for other than safety reasons. This new clause does not, by the authors' research, comply with the statutory Acts under which the National Construction Code is passed.

Keywords:

A2.2(4), Building Confidence Report, Combustible cladding, National Construction Code, Performance-based design brief.

Ontology-based Representation of Implicit and Explicit Knowledge for Job Hazard Analysis: Focusing on Water Infrastructure Jobs

Sonali Pandithawatta^{1*}, Raufdeen Rameezdeen¹, Seungjun Ahn², Christopher W.K. Chow¹ and Nima Gorjian^{1,3}

¹Sustainable Infrastructure and Resource Management, UniSA STEM, University of South Australia, 61-68 North Terrace Adelaide South Australia 5000, AUSTRALIA ²Department of Civil and Environmental Engineering, Hongik University, P506, 94 Wausanro, Mapo-gu, Seoul, 04066, REPUBLIC OF KOREA ³Sustainable Infrastructure, South Australian Water Corporation, 250 Victoria Square/Tarntanyangga Adelaide SA 5000, AUSTRALIA

thalpe_panditha_wattage_sonali.pandithawatta@mymail.unisa.edu.au; Rameez.Rameezdeen@unisa.edu.au; jun.ahn@hongik.ac.kr; Christopher.Chow@unisa.edu.au; Nima.GorjianJolfaei@sawater.com.au

* Corresponding author

Abstract:

Given that each construction infrastructure project is unique, it is necessary to perform a Job Hazard Analysis (JHA) for all high-risk activities in every construction project. Due to the dynamic nature of construction sites, JHA needs to be conducted before the job and then updated when new information is added. In most cases, JHA is performed manually, and it is challenging to reflect the changes in the construction plans or schedules in JHAs. Considering these challenges associated with JHA practices, previous researchers attempted to automate the JHA process by building ontology-based solutions. However, most of these studies have only considered the explicit knowledge of JHA and ignored the implicit knowledge for hazard identification and control, which is considered as one of the most important knowledge components in the process of JHA. Thus, this research attempts to represent the JHA knowledge based on both the explicit and implicit knowledge of JHA in a form of ontology, focusing on water infrastructure jobs. To achieve this goal, a document analysis on JHA documents and a qualitative Delphi method were adopted to identify the implicit and explicit concepts and relationships regarding the identification and control of various hazards from the practitioners. This paper provides the concepts related to JHA and the relationships among them that can be mapped onto an ontology for automating JHA processes

Keywords:

Conceptualisation, Job Hazard Analysis, Ontology, Safety management, Water infrastructure

Conceptual Framework for Suicide Prevention Process in Construction

Aparna Samaraweera^{1*}, TADK Jayasanka², Vidana Gamage Shanika³, Rameez Rameezdeen¹ and Sonali Alankarage¹

¹UniSA STEM, University of South Australia, Mawson Lakes, SA 5095, AUSTRALIA ²Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung Hom, Kowloon, HONG KONG ³Department of Building Economics, University of Moratuwa, Moratuwa, SRI LANKA

Aparna.Samaraweera@unisa.edu.au; kasunjayasanka22@gmail.com; vgshanika9@gmail.com; Rameez.Rameezdeen@unisa.edu.au; sonali_madhuwanthi.hewa_alankarage@mymail.unisa.edu.au * Corresponding author

Abstract:

Suicide claims a substantial health and social issue for Australian construction industry. Being a male dominant industry, construction workers are known to be at a greater risk for suicide than other occupational groups. Recently, this issue has received high attention of the Australian government due to the reason that majority of the suicide victims being younger and working age generation. However, still the research related to construction suicide does not cater for the actual necessities in suicide prevention of the sector. Thus, this research aims to develop a conceptual framework for suicide prevention process in construction. This aim was approached through a systematic literature review. 57 research papers were considered for the systematic literature review and data were analysed through a content analysis. Systematic literature review revealed five major themes of: 'Suicide Risk', 'Suicide Behaviour', 'Suicide Prevention', 'Suicide Intervention', and 'Suicide Postvention'. A conceptual framework was developed by mapping these five themes. According to the framework, 'suicidal behaviour' will be particularly elevated in those, who are at suicide risk. Elevated suicide desire, respectively, causes suicidal ideation, suicide attempts, and ultimately suicide death. To mitigate suicide behaviour, the framework establishes suicide prevention strategies, which include Suicide Prevention, Suicide Intervention and Suicide Postvention. This research outcome would be important for the future researchers, policymakers and other funding organisations to develop research agendas related to suicide prevention in the construction sector.

Keywords:

Construction industry, Mental health, Suicide behaviour, Suicide prevention, Suicide

Re-thinking Spatial Design in Homes to Include Means and Access Restriction with Material Impacts as Passive Suicide Prevention Methods: A Systematic Review of Design for Australian Homes

Michael Booth^{1*}, Pushpitha Kalutara² and Neda Abbasi ³

1School of Engineering and Technology, CQUniversity, Brisbane, Queensland 4000, AUSTRALIA 2School of Engineering and Technology, CQUniversity, North Rockhampton, Queensland 4700, AUSTRALIA 3School of Engineering and Technology, CQUniversity, Sydney, New South Wales 2000, AUSTRALIA

m.booth@cqu.edu.au; p.kalutara@cqu.edu.au; n.abbasi@cqu.edu.au * Corresponding author

Abstract:

This systematic review analyses research discovering commercial design applications that could be adopted for suicide prevention in homes. Furthermore, the study equips a larger systematic literature review capturing social, spatial and biophilic design methods to improve wellness in homes using environmental design psychology. Safety and human wellness frame this spatial design research examining access and means restriction to improve home safety and prevent suicides. Suicide is a growing phenomenology deserving attention considering environmental impacts. There is a substantial evidence base to evaluate suicide prevention methods used in high-risk environments of health and healing environments, workplaces, and incarceration facilities. This review discovers design methods using spatial arrangement and material choices to improve human wellness in homes. Biochemical reactions as toxicology impact show stress impacts from this research for design use considering material choices and applications to improve mental health in homes. Spatial design suicide prevention can guide various prevention measures, such as, adopting access and means restriction and environmental design methods for wellness, considering impacts during lock-down periods (e.g., during COVID-19). Environmental design psychology research supplies evidence for improved spatial arrangements in homes, with evidence showing design applications can restore and improve mental health. This systematic review shows evidence for planning methods to prevent suicides considering both access and means restriction with considerable biochemical impacts from design. Design methods discovered by this systematic review will be considered for future studies and used within economic modelling to demonstrate design guidelines to improve wellbeing and support existing suicide prevention methods, for Australian homes.

Keywords:

Environmental psychology, Home design, Spatial design, Suicide prevention, Value management

Theme:

Education in Built Environment

The 45th AUBEA Conference, 23-25 Nov. 2022, Western Sydney University, Australia

This page is intentionally left blank

A Transdisciplinary Learning Approach to Teaching Construction Entrepreneurship

Seng Hansen^{1*} and Susy F. Rostiyanti¹

¹Department of Construction Engineering & Management, Universitas Agung Podomoro Grogol, West Jakarta 11470, INDONESIA

seng.hansen@podomorouniversity.ac.id; susy.rostiyanti@podomorouniversity.ac.id * Corresponding author

Abstract:

Construction Entrepreneurship is a unique subject taught in the Construction Engineering and Management program at the Podomoro University in Indonesia. As a new course, it is necessary to develop an effective and efficient teaching syllabus. This paper describes construction entrepreneurship teaching through a transdisciplinary learning approach as an effective way to develop its syllabus. The transdisciplinary learning approach was chosen to provide insights of real-world problems to students through collaborative learning with industry speakers. Six construction entrepreneurs were invited to share their experiences in starting a construction business, followed by two reflective discussion forums to explore lessons learned from the sharing sessions. At the end of the term, online surveys were distributed to seek feedback from the enrolled students regarding the design, methods, and benefits of learning construction entrepreneurship. In addition, the survey was also intended for construction students who have never taken this subject to gain their perspectives on the relevance and interest of this subject. Overall, the approach to teaching construction entrepreneurship to enrolled students was found to be effective. The statistics also show the high level of student interest from other construction-related programs to take this subject.

Keywords:

Construction entrepreneurship, Entrepreneurs, Teaching, Transdisciplinary learning

Construction Engineering and Management: A Review of Australia-based Research

Tayyab Ahmad¹* Husnain Arshad Qazi² and Ajibade Ayodeji Aibinu³

¹Department of Civil and Architectural Engineering, Qatar University, QATAR ²Department of Building and Real Estate, Polytechnic University Hong Kong, HONG KONG ³Faculty of Architecture, Building and Planning, The University of Melbourne

³Faculty of Architecture, Building and Planning, The University of Melbourne, Parkville, Victoria, 3010, AUSTRALIA

tayyab@qu.edu.qa

* Corresponding author

Abstract:

Construction Engineering and Management (CEM) is an important discipline of the built environment providing a scientific and management-oriented perspective for construction projects. CEM research is highly context specific as it is governed by social needs, environmental challenges, and industrial issues. Australia is home to several universities engaged in CEM-related research and training. To understand the research trends in CEM discipline across Australian institutes, this study conducts a review of highly representative 3,748 CEM-related publications from Australian universities. This study helps see the research topics considered by CEM academics in Australia, the temporal changes in research topics, and the research collaboration among Australian institutes. The review has shown that CEM academics in Australia have high degree of collaboration with China and UK-based academics. In terms of publication volume, Curtin University, University of New South Wales (UNSW), Royal Melbourne Institute of Technology (RMIT) University, Queensland University of Technology (QUT), and Deakin University have performed extraordinarily. Some of the highly considered research topics by Australian CEM academics include performance assessment, energy, project design, BIM, project management objectives (i.e., safety, time, cost, quality), social aspects of construction, construction materials, sustainability, and project stakeholders. While this study provides a detailed understanding of the past CEM research trends in Australia, it also provides recommendations for future research development in Australia. The findings of this review will be able to generate a discussion regarding the improvement of CEM research across Australian institutes.

Keywords:

Australia, Collaboration, Construction Engineering and Management, Research trends, Review

Impact of the Construction Computing Software (CCS) 'Candy' Course: Construction Management and Quantity Surveying Students' Perceptions

John Smallwood^{1*}, Chris Allen¹ and Ashvin Manga¹

¹Department of Construction Management, Nelson Mandela University, PO Box 77000, Port Elizabeth, 6031, SOUTH AFRICA

john.smallwood@mandela.ac.za; chris.allen@mandela.ac.za; ashvin.manga@mandela.ac.za * Corresponding author

Abstract:

Students' post-course perceptions provide insight relative to their understanding and appreciation of a module, including the impact thereof within the context of the wider course content and its enhancement of a candidate's holistic knowledge. Hence the study reported on to determine construction management and quantity surveying students' post course perceptions regarding a CCS 'Candy' course presented at a South African university. The students were surveyed via an e-mailed self-administered questionnaire at the completion of the course. The salient findings include: 'planning – programming' predominates in terms of the extent Candy training contributed to an increase in knowledge; estimating, costing, coordinating, and planning predominate in terms of an enhancement of skills; programming and scheduling predominate in terms of contributing to an improvement in students' understanding and appreciation of seven activities of the planning function in an organisation, and; time predominates in terms of an improvement in students' understanding and appreciation of the project parameters. Conclusions include that the CCS Candy course had an impact in terms of: an enhancement of both knowledge and skills aligned with the planning function; a better understanding and appreciation of the practice of construction management and quantity surveying, and students understand and appreciate the importance and role of the course in terms of greater knowledge development. It is recommended that the 'add-on' certificated CCS Candy course continue to be included and that the research be conducted annually.

Keywords:

CCS Candy course, Construction Management, Perceptions, Quantity Surveying, Students

Using 360-Degree Virtual Tours to Teach Construction Students

Susan Mander^{1*}, Vishnupriya Vishnupriya¹ and Ruggiero Lovreglio¹

¹School of Built Environment, Massey University, Private Bag 102904, North Shore, Auckland 0745, NEW ZEALAND

S.Mander@massey.ac.nz; P.Vishnu@massey.ac.nz; R.Lovreglio@massey.ac.nz * Corresponding author

Abstract:

The COVID-19 pandemic restrictions made it necessary to move learning activities online, requiring educators to think outside the box to create authentic and experiential learning activities for students. This paper describes how virtual field trips were developed to actively engage construction students and evaluates the impact of the pedagogical technique on students' learning experiences through qualitative analysis. This exploratory study focused on understanding student experiences within a virtual learning environment. Off-the-shelf tools were used to develop online 360-degree virtual site tours to teach construction students at Massey University's School of Built Environment. Student feedback was collected to assess their perspectives on their learning after the virtual tour. The student responses indicate a high perceived impact on students' authentic learning and engagement within construction education. The research contributes to the growing knowledge base on the implementation of virtual tours in education and in supporting students in experiential learning. Our findings highlight enhanced students' experiential and authentic learning experiences in a remote learning environment.

Keywords:

360-degree virtual site tours, Construction education, Sustainable Development Goals (SDGs), Virtual classrooms, Virtual field trips

Taxonomy of Digital Skills Needed in the Construction Industry: A Literature Review

Fida Hussain Siddiqui^{1*} Amir Abdekhodaee² and Muhammad Jamaluddin Thaheem³

 ¹Department of Civil and Construction Engineering, School of Engineering, Swinburne University of Technology, Hawthorn, VIC 3122, AUSTRALIA
 ²Department of Mechanical Engineering and Product Design Engineering, School of Engineering, Swinburne University of Technology, Hawthorn, VIC 3122, AUSTRALIA
 ³School of Architecture and Built Environment, Deakin University, Geelong, VIC 3220, AUSTRALIA

*fsiddiqui@swin.edu.au, fida_siddiqui@hotmail.com; aabdekhodaee@swin.edu.au; jamal.thaheem@deakin.edu.au

* Corresponding author

Abstract:

The construction industry is currently on the pathway to digitalisation as per the ongoing fourth industrial revolution and post-COVID needs. However, it has been quite slow in doing that. One of the foundational causes of the lack of digitalisation or its slow adoption in the construction industry is the lack of adequate understanding of digital skills amongst the stakeholders. This study aims to develop a taxonomy of digital skills needed to digitalise the construction industry. Following the methodology of systematic literature review, Scopus and Web of Science databases were mined to assess the relevant literature and map the skills currently utilised or needed for this digitalisation. Mainly, the digital skills were extracted and categorised into automation and robotics, communication, design, drafting and engineering, etc. The developed taxonomy will help stakeholders to plan holistically and strategically for the digital skills needed in the upcoming graduates joining the workforce. The outcome also benefits academia by aiding the stakeholders to develop tailored pedagogical approaches and relevant curricula improvements to accommodate the need for digital skills. Digitalisation is the future and educational institutions can support this movement by providing the relevant skills to existing and returning students.

Keywords:

Construction industry, Digital skills, Digitalisation, Systematic literature review, Taxonomy

Perceptions of Architecture Degree Students Towards Sustainability in Buildings

Tayyab Ahmad^{1*} and Christhina Candido²

¹Department of Civil and Architectural Engineering, Qatar University, QATAR ²Faculty of Architecture, Building and Planning, The University of Melbourne, Parkville, Victoria, 3010, AUSTRALIA

tayyab@qu.edu.qa

* Corresponding author

Abstract:

For sustainable development and operation of buildings, architects have a critical role in converting the intangible project requirements into tangible reality. The industry-driven transition towards sustainability requires architects to have the necessary skills, knowledge, and experience to create sustainable buildings. Owing to the multidimensional nature of sustainability, and the multitude of challenges driving the sustainability agenda, the students of architecture may have varying opinions regarding sustainability attributes in buildings. Evaluating their viewpoint can give an essence of how future architects think about building sustainability. Accordingly, this study aims to provide a detailed account of the building sustainability perception of graduate-level architecture degree students at the University of Melbourne. Data was collected through two separate student activities. In the first activity, one cohort of students identified the attributes of sustainable and healthy buildings. In the second activity, a different student cohort indicated their agreement regarding a list of attributes for building sustainability. Interviews with three professional architects were also conducted to investigate the role of architects towards sustainable buildings. The outcomes of the activities reported in this study will help identify the shortcomings in the sustainability awareness of students and will help revisit the architecture degree curriculum to ensure high degree of sustainability understanding among students.

Keywords:

Architecture student, Building, Sustainability attributes, Sustainability awareness

Retention over Attraction: A Review of Factors Affecting Women's Experiences in the Australian Construction Industry

Amir Ghanbaripour^{1*}, Roksana Jahan Tumpa², Riza Yosia Sunindijo³, Weiwei Zhang¹, Parinaz Yousefian⁴, Ranka Novak Camozzi¹, Carol Hon⁴, Nima Talebian¹, Tingting Liu⁵, Mina Hemmati⁶

 ¹Faculty of Society and Design, Bond University, Gold Coast, QLD 4226, AUSTRALIA
 ² School of Engineering and Technology, Central Queensland University, Sydney, NSW 2000, AUSTRALIA
 ³ School of Built Environment, UNSW Sydney, Sydney, NSW 2052, AUSTRALIA
 ⁴ School of Architecture and Built Environment, Queensland University of Technology, Brisbane, QLD 4001, AUSTRALIA

⁵Cities Research Institute, School of Engineering and Built Environment, Griffith University, Southport, QLD 4222, AUSTRALIA

⁶Faculty of Business and Accountancy, University of Malaya, Kuala Lumpur, MALAYSIA aghanbar@bond.edu.au; roksanajahan.tumpa@cqumail.com; r.sunindijo@unsw.edu.au; wzhang@bond.edu.au; parinaz.yousefian@qut.edu.au; rnovakca@bond.edu.au; carol.hon@qut.edu.au;

ntalebia@bond.edu.au; tingting.liu@griffith.edu.au; hemmati.minaum@gmail.com * Corresponding author

Abstract:

Despite substantial investments and efforts by governments, construction organisations, and researchers, the construction industry remains one of the most male-dominated industries in Australia, with women being underrepresented numerically and hierarchically. Efforts to attract and retain women in construction have been implemented inconsistently on an ad hoc basis. As part of a larger research project that focuses on retaining women in the Australian construction industry, this research conducted a systematic literature review (SLR) in accordance with the PRISMA guidelines to identify the major factors that influence women's careers and their experiences in the Australian construction industry. The SLR revealed that excessive and rigid work hours, gendered culture and informal rules, limited career development opportunities, and negative perceptions of women's abilities are the main factors and issues that cause women to leave the industry. Among these, rigid and long work hours seem to be the foremost factor to be prioritised. Although long work hours can affect women more due to their family responsibilities, addressing this issue can lead to better work-life balance and mental well-being, which can benefit everyone. Understanding the roles of key variables in driving this cultural change is important to ensure that concrete progress is made. The findings are anticipated to inform future efforts to evaluate the effectiveness of current initiatives to retain women and develop a framework for enhancing women's experiences and retaining them in this profession.

Keywords:

Australia, Career experience, Construction, Retention, Women

Skill Transformation: Future Requirements, Implementation, and Academic Implications in Quantity Surveying and Construction Management Professionals in the New Zealand Construction Industry

Kam Yuen Cheng^{1*} and Cecily Zhou²

¹Engineering and Architectural Studies Department, Ara Institute of Canterbury, 130 Madras Street, Christchurch, NEW ZEALAND ²TOPA Partner Ltd (TOPA Electrical) 1/10 Musgrove Close, Wigram, Christchurch, NEW ZEALAND

Kam.cheng@ara.ac.nz; Cecily_0707@hotmail.com

* Corresponding author

Abstract:

The construction field is currently experiencing a profound transformation driven by technological evolution, climate changes, and wellbeing, especially after the disruption due to the pandemics in 2020, which highlights the importance of preparing students for the types of careers that will be available to them in the future. Construction and quantity surveying programmes in New Zealand are typically at the diploma level taught in polytechnics; there is no existing research about skill transformation in the New Zealand construction industry. This study aims to identify future skill requirements to investigate how the academic curriculum will be transformed in response to changes in their employability demand by the industry over the coming three to five years and set the graduates up for future success in New Zealand. The study consists of questionnaires sent to academics and practitioners and subsequent thematic analysis of the result is performed under smart competencies, resilience competencies and sustainability competencies. The study shows that data analytics and STEM knowledge, teamwork and communications, energy management and circular economy under the three thematic categories and their interactions with one another hold information that can lead to recommendations for the design of construction and quantity surveying programmes.

Keywords:

Construction, Future skills, Higher education, Sustainability, Transformation

A Review of Immersive Technology Applications in Occupational Health and Safety Training in the Construction Industry

Arka Ghosh^{1*} and Abid Hasan²

¹School of Information Technology, Deakin University, Geelong, VIC 3220, AUSTRALIA ²School of Architecture and Built Environment, Deakin University, Geelong, VIC 3220, AUSTRALIA

ghoshar@deakin.edu.au; abid.hasan@deakin.edu.au

* Corresponding author

Abstract:

Training of the workforce is an integral component of the occupational health and safety (OHS) management system on construction sites. However, the traditional training styles have been criticised for their failure to capture the complexities of the construction site environment, potential accident scenarios and workers' responses or behaviour. Immersive technologies like AR (Augmented Reality), VR (Virtual Reality) and MR (Mixed Reality) could change the content and delivery of OHS training in the construction industry. The present study reviews 42 journal articles published on the application of immersive technology in OHS training in the construction industry. It illustrates various applications of immersive technologies, along with prominent researchers, organisations and countries active in this research area. Furthermore, it offers insights into four major research clusters of immersive technology applications: (1) improved risk management, (2) efficient resource usage, (3) computer-based hazard simulation, and (4) better OHS decisions.

Keywords:

Construction workers, Immersive technology, Safety, Training, Virtual reality

Application of Immersive Technologies in Construction Education: An Experimental Study of Project Scheduling

Muhammad Sami Ur Rehman¹, Narmin Abouelkhier¹, and Muhammad Tariq Shafiq^{1*}

¹Department of Architectural Engineering, College of Engineering, United Arab Emirates University, 15551, Al Ain, Abu Dhabi, UAE

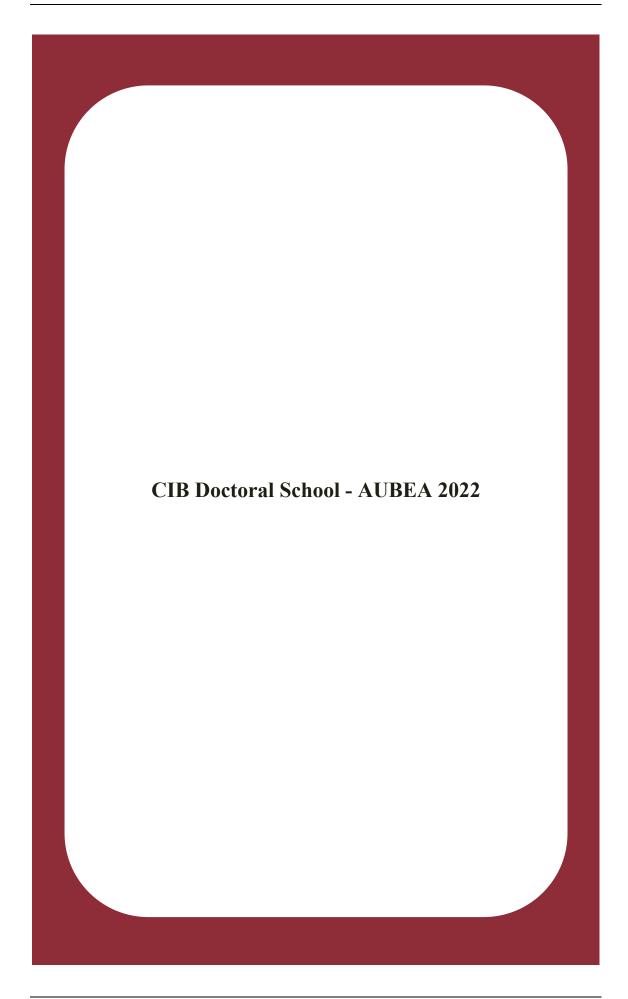
202090209@uaeu.ac.ae; 700039609@uaeu.ac.ae; muhammad.tariq@uaeu.ac.ae * Corresponding author

Abstract:

The advent of immersive technologies, such as Virtual Reality (VR) headsets, enabled a unique experience of the physical world in a virtual and interactive environment. Such distinct interactive experiences have opened a plethora of possibilities for immersive learning by bringing real-world situations to a virtual interactive environment. Similarly in education, immersive learning enables students to experience real-world scenarios in a convenient and controlled environment that otherwise may not be feasible and safe. The integration of immersive technologies in mainstream technical education delivery is still in its infancy and limited research is available on its ability to effectively deliver technical content in a classroom environment. This experimental research study aims to gauge the effectiveness of immersive technologies in delivering technical concepts to the participants of the undergraduate-level construction project planning course. This study reports the findings of an experiment that recorded undergraduate students' learning and understanding of construction sequencing and scheduling by using a set of twodimensional construction drawings and a Critical Path Method (CPM)-based construction schedule to identify any scheduling setbacks. The same test case was repeated with the use of an immersive environment by carefully monitoring the activitybased layers. The findings of this study suggest that the comparative analysis of traditional teaching methods and technologically advanced immersive methods showed a significant difference in students' ability to understand technical concepts and highlight any errors in the construction sequence. The paper presents the details of the experiment and a comparative analysis of both approaches in terms of student learning and understanding of project planning, sequencing, and scheduling.

Keywords:

Construction education, Construction scheduling, Immersive technologies, Project planning, Virtual reality



This page is intentionally left blank

Community-focused Renewable Energy Transition with Virtual Power Plant in an Australian City – A Case Study

Chengyang Liu¹, Rebecca Yang^{1*} and Kaige Wang¹

¹Solar Energy Application Lab, School of Property, Construction and Project Management, RMIT University, Melbourne, VIC 3000, AUSTRALIA

chengyang.liu2@rmit.edu.au; rebecca.yang@rmit.edu.au; kaige.wang@rmit.edu.au * Corresponding author

Abstract:

As renewable energy becomes more competitive in terms of costs, benefits, and energy production, the transition to a renewable-powered economy is gaining traction around the world. With greater flexibility and economic potential through supplying renewable energy, participating in the electricity market, and providing electricity network services, renewable energy integrated Virtual Power Plants (VPPs) have the advantages of facilitating renewable transition, reducing impacts of distributed generators, and creating values for the prosumers and community. However, although gifted with abundant renewable resources and supported by state and commonwealth-level incentives, there are still multiple technical and economic uncertainties, such as the financial viability of the investment and the effectiveness of the renewables transition. In this paper, we conducted a case study in the City of Greater Bendigo to evaluate the challenges and opportunities of the community-focused renewable energy transition through establishing VPP with community-based renewable generators and storage systems. We formulated the VPP system with a reinforcement learning algorithm capable of making optimal decisions regarding energy supply, demand shift, and market trading. It was found that the proposed VPP system has great potential in improving the economic value and carbon emission reduction performance of the local renewable resources in the future: it is capable of reducing 50-70% of the case study city's carbon emission in 10 years, and reducing the electricity price from the current range of \$ 0.15/kWh (off-peak) - \$ 0.30/kWh (peak) as provided by Victorian Essential Services Committee to a much lower range of \$ 0.05/kWh (off-peak) - \$ 0.08/kWh (peak). Overall, this study proposed a comprehensive framework to investigate community-based VPP in a complex urban environment and validated the efficacy of the VPP in supporting the renewable transition for Australian communities.

Keywords:

Community-focused, Case study, Distributed renewable energy, Reinforcement learning, Virtual power plant

Dynamic Construction Scheduling and Resource Planning Based on Real-time Project Progress Monitoring

Kartika Nur Rahma Putri¹, Ziang Jiang¹, Xuesong Shen^{1*} and Khalegh Barati¹

¹School of Civil and Environmental Engineering, University of New South Wales (UNSW Sydney), Kensington, Sydney, NSW 2052, AUSTRALIA

k.putri@unsw.edu.au; ziang.jiang@unsw.edu.au; x.shen@unsw.edu.au; khalegh.barati@unsw.edu.au * Corresponding author

Abstract

Effective management of resources, such as materials, equipment, and workers, is critical to the success of a construction project. It requires adequate project monitoring to match resource needs with available resources to prevent idling. Currently, resource planning in construction projects usually relies on a static master schedule. At the same time, the change of schedule will interchangeably impact the change of material demands. Thus, accurate construction progress will be needed to ensure that the resources can be available on-site just in time. Nowadays construction progress tracking is typically performed manually. Previous studies have tried applying digital technologies such as laser scanners, image processing, and photogrammetry to capture the construction progress. However, the benefits of progress monitoring have not been widely used in dynamic project scheduling and resource planning. This paper aims to develop a framework for using the latest progress monitoring digital technologies to support accurate prediction about resources needed. To overcome this issue, construction progress monitoring was generated by comparing as-planned building information model (BIMs) with the as-built 3D point clouds taken by a laser scanner. The duration of the upcoming activities was predicted using past historical data on the team's productivity. The updated progress monitoring and prediction of activities will be used to estimate the resources needed for some weeks ahead. The results indicate that the proposed framework could effectively predict the resources needed to support construction site decision-making.

Keywords:

Construction, Dynamic scheduling, Progress monitoring, Resource management

Issues in Compliance with Low-Carbon Requirements in the Australian Residential Building Industry

Yi Lu^{1*}, Gayani Karunasena² and Chunlu Liu³

¹²³School of Architecture and Built Environment, Deakin University, Geelong VIC 3220, AUSTRALIA

 1 yi.lu@deakin.edu.au; 2 gayani.karunasena@deakin.edu.au; 3 chunlu.liu@deakin.edu.au * Corresponding author

Abstract:

Low-carbon requirements have long been acknowledged as critical instruments to facilitate residential building industry's transition toward decarbonization in Australia. However, recent studies in the residential building sector have shown that compliance with low-carbon requirements is under-researched, which has led to a significant divergence between low-carbon requirements' intentions and actual performance. Therefore, based on the methodology of literature review, the paper aims to provide a comprehensive exploration of issues in compliance with low-carbon requirements within the Australian residential building industry. Through reviewing research works and policy documents, the paper firstly demonstrates the Australian developments in promoting low-carbon residential buildings, by summarizing key low-carbon requirements and their corresponding purposes. This highlights the significance of these requirements in spurring emission reduction from residential buildings. Subsequently, relying on regulatory studies concerning the National Construction Code (NCC) energy efficiency provisions, the paper reveals the wide presence of non/under-compliance challenges across every construction stage. It further indicates that such issues are largely attributed to major stakeholder groups including regulators (policymakers, building control officers), regulated building practitioners and occupants. Finally, the paper identifies research gaps and proposes future works in the areas of enhancing enforcement regimes, design of the energy simulation tool, raising occupants' awareness and investigating building practitioners' compliance behaviour. The paper implies the urgency to investigate the suboptimal compliance phenomena in the Australian residential building industry, as these issues have already impeded the achievement of the industry's low-carbon future. It also brings contributions via enlightening future research areas to address the issues.

Keywords:

Building practitioner, Compliance, Energy efficiency, Low-carbon, Residential building industry

A Review of Using Augmented Reality to Improve Construction Productivity

Zhidong Xu¹*, Mostafa Babaeian Jelodar¹, Zhenan Feng¹, and Brian HW Guo²

¹School of Built Environment, Massey University, NEW ZEALAND ²Department of Civil & Natural Resources Engineering, University of Canterbury, NEW ZEALAND

zxu1@massey.ac.nz; m.b.jelodar@massey.ac.nz; z.feng1@massey.ac.nz; brian.guo@canterbury.ac.nz * Corresponding author

Abstract:

Low productivity has been a long-term issue in the construction sector. Human-made errors, lack of experience, and poor management are the common factors that cause low productivity. Low productivity can result in significant delays and economic losses to construction projects. Researchers have introduced innovative approaches to improve construction productivity, such as Augmented Reality (AR). Previous studies focused on state-of-art AR applications in different construction domains. There is little literature review studying AR applications in construction activities from the technical aspect and impact on productivity. This paper reviews AR technologies in the planning, design, and construction phases of construction projects and studies the leverage of AR technologies in improving construction activities and improved productivity factors. This paper demonstrates the capability of AR to improve construction productivity.

Keywords:

Augmented reality, Construction industry, Literature review, Productivity

Enhancing the Decision-Making Process of Life Cycle Assessment Towards Circular Economy Measurement in the Construction Industry

Prince Antwi-Afari^{1*} Thomas S.T. Ng², Ji Chen¹, Benjamin I. Oluleye³, Maxwell F. Antwi-Afari⁴ and Benjamin K. Ababio⁵

 ¹Department of Civil Engineering, The University of Hong Kong, Pokfulam, Hong Kong
 ²Department of Architecture and Civil Engineering, City University of Hong Kong, 83 Tat Chee Avenue, Kowloon Tong, Hong Kong
 ³Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong
 ⁴ Department of Civil Engineering, College of Engineering and Physical Sciences, Aston University, B4 7ET, Birmingham, UK
 ⁵Department of Real Estate and Construction, The University of Hong Kong, Pokfulam, Hong Kong

pantwiaf@connect.hku.hk; thomasng@cityu.edu.hk; jichen@hku.hk; benjamin.oluleye@connect.polyu.hk; m.antwiafari@aston.ac.uk; bababio@connect.hku.hk *Corresponding author

Abstract:

Life cycle assessment (LCA) has become one of the key methods used to assess the environmental impact of materials. The adoption of LCA to also assess circularity of construction materials has been proposed and ongoing in extant studies. However, LCA results for circular economy (CE) analysis are fraught with several challenges such as not accounting for reuse possibilities, lack of pragmatic applicability at design and development stages, challenges with system boundaries and inability to assess social implications of product system. In this study, the system boundary of LCA is extended to cradle-to-cradle to include the impacts of the end-of-life reuse pathways in assessments while adopting the predictive building systemic circularity indicator to also measure the recoverability potential of modular steel slabs. The adoption of this integrative iterative approach should enhance the determination of impacts and recovery potentials of materials across several dimensions. It was identified that the circularity and impact potentials of the product system is influenced by the recyclability plan, recycled content, average product utility and normalisation factor of the case slab. To ensure practical realisation of CE, there is therefore the need to plan the end-of-life reuse pathways and determine the impacts of various decisions across product systems from the beginningof-life.

Keywords:

Life Cycle Assessment, Circular economy, Cradle-to-cradle, Construction industry, Modular buildings

A Method for Establishing an Infrastructure of Play within the Houses of Apartment Buildings

Dalia Bukhamsin

School of Architecture & Built Environment, The University of Newcastle, University Dr. Callaghan, NSW 2308, AUSTRALIA

daliajafara.bukhamsin@uon.edu.au

* Corresponding author

Abstract:

An urban environment requires various forms of infrastructure to sustain living within its boundaries. The main purpose of such infrastructure is to connect residential areas to the city and its environment. For those who live in apartment buildings, many of these infrastructures provide the core services that enable many houses to exist above the ground and within one building. Some of the challenges with apartment buildings are inflexible and inadaptable. One of the interventions adopted in response to these challenges is the creation of PLAY-driven. PLAY is the relationship between understanding spatial qualities and spatial design when planning houses. The study aimed to evaluate the techniques and systems that create PLAY within a house. Specific objectives included; To evaluate the extent to which PLAY exists within apartment houses and determining whether it is a desirable characteristic; To design furniture and fixtures for apartment houses that enable a greater capacity for PLAY; and To analyse how the design of future apartment houses can incorporate PLAY. Regarding methodology, the study adopted a literature review and a case study, which involved analysing the Honeysuckle HQ apartment complex project, an apartment in Newcastle, Australia. The study outcomes indicated that adjacency could be exploited to enhance apartments' functionality. The study further emphasises the need for enhanced structural and functional features, including ventilation, connectivity, and outdoor space. Most importantly, the study found that architects must ensure that their apartment's designs can be aligned with the individual needs of occupants.

Keywords:

Adaptability, Architecture, Infrastructure, Living patterners, PLAY

Development of Conceptual Motivational Framework to Improve Construction Labour Productivity in the U.K.

John Kojo Tawiah Hayford^{1*}, Timothy Eccles¹, Daniel Fong¹ and John Obas Ebohon¹

¹Centre of Integrated Delivery of the Built Environment, School of Built Environment and Architecture, London South Bank University, UNITED KINGDOM

hayforj2@lsbu.ac.uk; ecclest@lsbu.ac.uk; fongd@lsbu.ac.uk; ebohono@lsbu.ac.uk * Corresponding author

Abstract:

The theoretical study presents vital motivational factors influencing labour productivity and understanding the relationship between motivation, social compliance, and labour productivity for decision-making. Labour motivation is essential because the quality of labour performance depends upon motivation. Labour who put forth more effort makes a big difference in company productivity. The construction industry in the U.K. is to become Europe's largest construction market by 2030. However, the trend of construction industry productivity in the U.K. has been low relative to other industries resulting in a skilled labour shortage, project delays, high construction costs, and low productivity growth as foreign migrants execute most projects. The U.K. serves as a security for the concerns of Middle Eastern and other war-torn countries, including the effects of the Ukraine war. It is the largest market for U.S.A. service exports, thus accepting more migrants. Therefore, demands for housing projects are ever-increasing, leading to a rise in construction projects that present opportunities for research to improve productivity through motivation by enhancing social compliance. The findings indicate that motivation mediates social compliance and labour productivity and that the essential way to motivate labour is by upholding social compliance. The present study conducts a comprehensive literature review to identify motivational factors influencing labour productivity. The findings developed a conceptual motivational framework that indicates a positive relationship between motivation, social compliance, and labour productivity. The next level is to test the framework on construction sites empirically through pragmatism philosophy with quantitative and qualitative approaches.

Keywords:

Construction productivity, Motivational factors, Motivation framework, Productivity, Social compliance

Optimal BIM and LCA Integration Approach for Embodied Environmental Impact Assessment in Early Building Design

Yijun Zhou¹, Vivian WY Tam¹* and Khoa N. Le¹

¹School of Engineering, Design & Built Environment, Western Sydney University, Locked Bag 1797 Penrith NSW 2751, AUSTRALIA

19896117@student.westernsydney.edu.au; v.tam@westernsydney.edu.au; k.le@westernsydney.edu.au * Corresponding author

Abstract:

Embodied environmental impacts of buildings refer to the resource consumption and environmental consequences produced in manufacturing, construction, and end-of-life stages of buildings. They are responsible for a large proportion of the total building environmental impacts. Embodied environmental impacts of buildings highly depend on the design decisions made in early design stages. Thus, it is considered important to examine the embodied environmental impacts in the early design practice for reducing the environmental impacts from building sector. Five BIM and LCA integration approaches have been developed to assess the environmental impacts of buildings. Appropriate choice of BIM-LCA integration approaches was proven to decrease time for assessment, improve accuracy of assessment results, and reduce the complexity of calculation processes in environmental impact assessment. However, the optimal BIM-LCA integration approaches for assessing the embodied environmental impacts in early design practice remains unclear. To address the issues, this research explores five BIM-LCA integration approaches to figure out the optimal one for assessing embodied impacts in early design by using non-structural fuzzy decision-making method. The results reveal that the approach of "using visual programming languages" is the optimal BIM-LCA integration approach for assessing environmental impacts in the early design stages, while the approach of "exporting BOQ into dedicated LCA tool" seems to be the least effective. The outcome of this research assists LCA practitioners in understanding the applicability of various BIM-LCA integration approaches and selecting the optimal BIM-LCA integration approaches in early design. Moreover, this research further promotes the applications of BIM-LCA integration approaches during the early design process of buildings.

Keywords:

Building design, Building Information Modelling, Life Cycle Assessment

Identifying the Validity of Success Indicators in the 'Build Back Better' Approach

Francis Hubbard^{1*} and Regan Potangaroa¹

¹School of Built Environment, Massey University, Albany campus, Auckland 0632, NEW ZEALAND

f.hubbard.nz@gmail.com; R.Potangaroa@massey.ac.nz

*Corresponding Author

Abstract:

'Build Back Better' is an ethics-based approach in humanitarian-led post disaster recovery yet, the 'Global Humanitarian Overview'(GHO) published in 2022 called attention to ever-increasing number of internally displaced people following disasters. This suggests that despite humanitarian delegates consistently reporting on success, outcomes of their deployments are not resulting in long term sustainable solutions. It has been well established that in knowing the indicators of success (or the components of a successful indicator), the probability of relief efforts continuing to be effective after humanitarian assistance ends increases expediently. Therefore based in the findings of the GHO, 'Build Back Better' indicators are either not sufficient suggesting the need for new indicators to be uncovered or, current indicators are sufficient but are not being used to guide activities to achieving outputs in a BBB approach. This papers aim is to explores these statements by first clarifying and introducing 'Build Back Better', its principles, and intended application. Secondly, highlight the impacts of a poorly executed 'Build Back Better' approach by exploring implications of the 'No-Build-Zone' policies in the Philippines following typhoon Haiyan in 2013, and analyse the most recently identified indicators of success from the latest 'Build Back Better' framework using hierarchical structural programming. This papers findings identify a new way to prioritise the existing indicators and suggest a better way to interpret and action the 'Build Back Better' framework for long term sustainable solutions.

Keywords:

Build Back Better, Humanitarian, Indicators, Post-disaster, Theory vs practise

Buildings' Indoor Environmental Conditions: A Thematic Analysis of Verbatim Comments from University Library Stakeholders

De-Graft Joe Opoku^{1*}, Srinath Perera¹, Robert Osei-Kyei¹, Maria Rashidi², Keivan Bamdad¹ and Tosin Famakinwa³

¹Centre for Smart Modern Construction (c4SMC), School of Engineering, Design & Built Environment, Western Sydney University, Locked Bag 1797 Penrith NSW 2751, AUSTRALIA ²Centre for Infrastructure Engineering (CIE), School of Engineering, Design & Built Environment, Western Sydney University, Locked Bag 1797 Penrith NSW 2751, AUSTRALIA ³Teaching and Research Technical Services (TRTS), Built Environment and Engineering Cluster, Western Sydney University, Locked Bag 1797 Penrith NSW 2751, AUSTRALIA

d.opoku@westernsydney.edu.au; srinath.perera@westernsydney.edu.au; r.oseikyei@westernsydney.edu.au; m.rashidi@westernsydney.edu.au; k.bamdad@westernsydney.edu.au; t.famakinwa@westernsydney.edu.au

* Corresponding author

Abstract:

Building users' comfort and satisfaction are significant factors in ensuring the overall productivity levels of its users. In recent times, considerable attention has been geared towards managing building occupants' comfort, energy use and improving the indoor environmental quality (IEQ) of buildings. However, little attention has been focused on the occupants themselves. The lack of attention to building users, their perceptions and opinions hinder the ability to fully address the users' comfort to improve their productivity within these buildings. Therefore, this paper examines the building's indoor environmental conditions from the users' perspective to improve their comfort, satisfaction and productivity. Semi-structured interviews were carried out with users of a university library building in Australia who were purposively selected. This library building is used as a case study for this research. The results from a thematic template analysis revealed energy consumption patterns and disturbing indoor environmental conditions experienced in buildings. Further, the results disclosed significant strategic measures to improve building users' comfort and productivity. These measures include shifting energy costs from weekends to weekdays, introducing daylight harvesting systems, ensuring greater external shading, introducing adequate blinds and shutters, and avoiding extensively large openings in buildings. The study outcomes present significant strategies for building managers in improving facility management. In addition, the findings can aid in enhancing building users' comfort, satisfaction and productivity. Finally, the findings contribute to knowledge on improving the IEQ of buildings.

Keywords:

Indoor environmental parameters, Occupant behaviour, Productivity, University library, User comfort

Improving Decision-making of Building Projects Towards a Smart and Sustainable Future via the Integration of Life Cycle Sustainability Assessment and BIM-based Digital Twin

Karoline Figueiredo^{1*}, Vivian W.Y. Tam², Ana C.J. Evangelista³ and Assed Haddad¹

¹Programa de Engenharia Ambiental, Universidade Federal do Rio de Janeiro, Rio de Janeiro 21941-901, Brazil.
 ²School of Engineering Design & Built Environment, Western Sydney University, Locked Bag 1797 Penrith NSW 2751, Australia.
 ³Engineering Institute of Technology, Perth, Australia.

karolinefigueiredo@poli.ufrj.br; v.tam@westernsydney.edu.au; ana.evangelista@eit.edu.au; assed@poli.ufrj.br

* Corresponding author

Abstract:

Buildings play a critical role in sustainability due to the massive environmental, social, and economic impacts generated throughout their life cycles. Although the search for sustainability is growing globally, developing sustainable building projects continues to be a challenging task linked to multiple criteria. The Life Cycle Sustainability Assessment (LCSA) methodology appears as a possible solution to meet the requirements of a sustainable built environment by adopting a lifecycle perspective and simultaneously accounting for all sustainability pillars. Nevertheless, compared to other assets, a building sustainability assessment requires extensive data processing. In this context, integrating LCSA and BIM-based Digital Twin from the early design stages of building projects, when it is possible to ensure maximum control over project decisions, to the building's end-of-life seems appropriate. A building Digital Twin can improve realtime data visualisation and develop self-learning building capabilities. Besides, the digital model can facilitate the simulations and data collection required to generate detailed results on impacts during sustainability assessments. Therefore, this study aims to extrapolate the discussion on integrating BIM and LCSA by adding the Digital Twin concept throughout the whole building's life cycle and inserting real-time data, thus transforming the application into a dynamic LCSA. To this end, this study proposes a conceptual framework with the steps to integrate LCSA and BIM-based Digital Twin throughout the entire building lifecycle to improve the design, fabrication, construction, operation and deconstruction processes. The advantages and challenges of using these concepts to achieve a smart and sustainable construction industry are discussed.

Keywords:

BIM, Decision-making, Digital Twin, Life Cycle Sustainability Assessment, Sustainable construction.

Self-rated Motivational Drivers for Occupant Behaviours: A Case Study of Tertiary Office Buildings

Achini Shanika Weerasinghe^{1*}, Eziaku Onyeizu Rasheed¹ and James Olabode Bamidele Rotimi¹

¹School of Built Environment, Massey University, East Precinct, Gate 1, Albany Expressway (SH17), Albany 0632, NEW ZEALAND

A.Weerasinghe@massey.ac.nz; E.O.rasheed@massey.ac.nz; J.Rotimi@massey.ac.nz * Corresponding author

Abstract:

Occupant behaviour is a significant contributor to the energy consumption of buildings. Dynamic and complex factors drive occupant behaviours, necessitating a focus on how occupants' comfort preferences, perceived user control, and other subjective factors influence such behaviours. Therefore, this paper presents findings from a case study of occupants' perceived environmental beliefs, individual control, and multi-domain reasons for their behaviours, considering the seasonal variance and time-related factors in a New Zealand tertiary office building. The data were collected through online surveys from 99 office occupants and evaluated using descriptive analysis to highlight the relationships between the study variables. The results highlight that the occupant behaviours are motivated by their comfort preferences and other subjective aspects. However, occupants may be conservative in evaluating the perceived indoor environmental quality (IEQ) satisfaction and control, and their influence is relatively unknown. Therefore, the study will help researchers, policymakers, energy modelers, and building managers to identify these hindrances to improving occupant behaviour models.

Keywords:

Building control, Comfort preferences, Energy saving, Indoor environment, Occupant behaviours

Sustainability-Enabling Field in Mega Transport Projects: Insights from Two Cases in India

Nicola Thounaojam¹, Ganesh Devkar² and Boeing Laishram^{1*}

¹Department of Civil Engineering, Indian Institute of Technology Guwahati, Guwahati, India ²Faculty of Technology, CEPT University, Ahmedabad, India

nicola@iitg.ac.in; ganesh.devkar@cept.ac.in; boeing@iitg.ac.in * Corresponding author

Abstract:

Many mega transport projects (MTP) have been planned and implemented worldwide to improve urban mobility and promote sustainable transportation. These MTPs provide enormous opportunities to reduce carbon footprints and improve socio-economic activities in an urban setting. In recent years, there has been an increasing interest in investigating the sustainability principles of MTPs because of short-to-long-term environmental and socio-economic impacts and shortfalls in efforts from governments and public and private parties. MTPs are not closed systems; influences in institutionalising sustainability come from interactions and interventions of actors in the field and institutional drivers. Therefore, using the lens of the organisational field and empirical data from two metro rail projects in India, this study attempts to examine the elements that frame the institutionalisation of sustainability in mega transport projects. This study used multiple data sources (interviews, documents, media reports) to identify various sustainability-enabling fields aspects, including actors in the field, institutional logics and governance arrangements. The findings show emergence of diverse field actors and governance arrangements, some parallels between the two projects and some arranged differently. In addition, the findings reveal multiple logics co-existing in the projects that aid or impede field actors from engaging in sustainable performance and outcomes of sustainable practices. Projects' institutional environments related to institutionalisation of sustainability differ; therefore, comparing the two cases provides an interesting context to examine the dynamics of institutional logics and context-specific institutions. Understanding the field and dynamics that trigger and support sustainability actions is critical for decision-makers in advancing sustainable development in megaprojects.

Keywords:

Infrastructure, Institutional theory, Megaprojects, Organisational field, Sustainable development

Reaching Net-Zero Targets in the Construction Industry by 2050: Critical Review of the Role of Public-Private Partnerships

Isaac Akomea-Frimpong^{1*}, Xiaohua Jin¹ and Robert Osei-Kyei¹

¹School of Engineering, Design & Built Environment, Western Sydney University, Locked Bag 1797 Penrith NSW 2751, AUSTRALIA

19624802@student.westernsydney.edu.au, xiaohua.jin@westernsydney.edu.au, r.osei-kyei@westernsydney.edu.au

*Corresponding author

Abstract:

In recent times, net-zero emission target has gone viral as the actionable step to cut down global carbon emissions to the lowest point. At COP26 (United Nations Climate Change Conference) held in Glasgow (UK) in 2021, world leaders pledged to formulate and implement policies to make this target a reality in all sectors including the construction sector. The construction sector is a key segment of the economy that emits huge percentage of carbon dioxide (CO2). This calls for attention and concerted solutions from key stakeholders of the construction sector to tackle the problem. The partnerships between the public and the private sector, termed as, public-private partnership (PPP), is a viable project model to solve this problem. However, limited studies exist on the role PPPs can play in achieving net-zero in construction projects. Thus, this study aims at exploring the role of public-private partnerships in net-zero emission targets in construction projects. The study utilises three-step literature review methodology. It begins with a comprehensive retrieval of literature, followed by selection of relevant articles, and ends with analysis of the bibliographical data. The findings include risk sharing, financial investment, influence carbon regulations, awareness creation, and education that PPPs offer to minimise carbon emissions in the construction projects. The outcomes of the study are relevant to further studies, policies, and practice.

Keywords:

Carbon emissions, Construction industry, Net-zero target, Public-private partnerships (PPPs)



Book of Abstracts



Conference Proceedings



AUBEA 2022 Webpage



Centre for Smart Modern Construction (c4SMC) Webpage

Notes



Centre for Smart Modern Construction

School of Engineering, Design and Built Environment



wsu/soedbe



@westsyduedbe



WSU Engineering, Design and Built Environment



/company/school-of-engineeringdesign-and-built-environment

Centre for Smart Modern Construction (c4SMC)



wsu/c4smc



@c4smc



Centre for Smart Modern Construction



/company/c4smc

