Abstracts for the Proceedings of the 11th International Conference on Construction in the 21st Century (CITC-11)

London, United Kingdom
September 9-11, 2019

Editors:
Syed M. Ahmed, Paul Hampton, Amelia D. Saul, Salman Azhar, Norma A. Smith, Shaunna C. Campbell, & Kelly L. Mahaffy

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Abstracts for the Proceedings of the

Construction in the 21st Century
11th International Conference (CITC 11)

September 9th-11th, 2019 – London, United Kingdom

Editors

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Quantity Surveyors International (QSI)

Construction Management Association of America (CMAA)

Foreword

While technology and innovation are shrinking, the distance between countries and industries and leadership and collaboration are actively shaping the construction industry, as well as guiding it towards success. Construction in the 21st Century (CITC) is an organization based in the Department of Construction Management at East Carolina University. The CITC-11 conference is being organized in collaboration with University of Wolverhampton and supported by Auburn University, RICS, QSI, CIOB, CMAA, and Babcock University. CITC organizes international conferences to bring together like-minded construction management professionals. The CITC-11 conference seeks to bring together an international group of practitioners, researchers, and educators to promote a novel exchange of ideas in a multidisciplinary fashion.

CITC-11 is a peer-reviewed conference that acts as a dynamic collaboration for the exchange of knowledge. New methods and techniques must be carefully scrutinized and rigorously tested before implementation, and CITC-11 plays an integral role in this process. As the industry moves forward in an ever-complex global economy, multi-national collaboration is crucial. Future growth in the industry will undoubtedly rely on international teamwork and alliance.

This September marks the eleventh CITC conference. Previous conferences include CITC-I in Miami of 2002, CITC-II in Hong Kong of 2003, CITC-III in Athens of 2005, CITC-IV in Gold Coast, Australia of 2007, CITC-V in Istanbul of 2009, CITC-VI in Kuala Lumpur of 2011, CITC-VII in Bangkok of 2013, CITC-8 in Thessaloniki, Greece of 2015, CITC-9 in Dubai of 2017, and CITC-10 in Sri Lanka of 2018. All conferences were tremendously successful. As with previous conferences, this effort has been greatly supported by our friends and colleagues across the globe. It is our pleasure to now present to you the Eleventh International Conference on Construction in the 21st Century (CITC-11, London). This three-day conference is being held in London at the RICS Headquarters. CITC-11 will bring together a diverse group of academics, professionals, government agencies, and students from all over the world to contribute to the future growth of the industry.

We gratefully appreciate your attendance and hope that you will support the future endeavors of CITC.

Thank you and kind regards,

Editors:

Syed M. Ahmed

Paul Hampton

Amelia Saul

Salman Azhar

Shaunna Campbell

Norma A. Smith

Kelly Mahaffy

ISBN: 978-1-7324416-3-7
September 2019
Greenville, North Carolina, USA

Appreciation

We appreciate the hard work and assistance of the following people in the organization of the conference:

Dr. Paul Hampton, *University of Wolverhampton*

Richard Ackroyd, *Royal Institute of Chartered Surveyors*

Aneeta Hazir, *University of Wolverhampton*

Johanna Nobel, *University of Wolverhampton*

Lauren Clarke, *University of Wolverhampton*

Suzanne Miller, *Quantity Surveyors International*

Chris Blythe, *Chartered Institute of Builders*

Caroline Gumble, *Chartered Institute of Builders*

Brenda Battle-Simms, *East Carolina University*

Taylor Wynn, *East Carolina University*

As well as those who assisted in the paper review process:

Dr. Amin K. Akhnoukh

Dr. Lincoln Forbes

Dr. Jodi Farrington

Thank you!

CITC-11 Themes

- Leadership in Engineering & Construction
- Architectural Management
- Building Information Modeling
- Automation and Robotics
- Lean Construction Practices
- 3D Printing
- Augmented and/or mixed reality
- Legal issues in Construction
- Value engineering
- Procurement Management
- Project and Program Management
- Quality and Productivity Improvement
- Risk Analysis & Management
- Sustainable Design and Construction
- Concrete Technology
- Construction Contracts
- Construction Equipment Management
- Construction Safety
- Construction Scheduling
- Cost Analysis & Control
- Cultural Issues in Construction
- Design-Build Construction
- Engineering & Construction Materials
- Ethical Issues in Engineering and Construction
- Information Technology and Systems
- Infrastructure Systems and Management
- International Construction Issues
- Innovative Materials (ultra-high-performance concrete, self-healing concrete, photocatalytic "self-cleaning concrete," etc.)
- Asphalt concrete (super-pave, etc.)
- Recycled and waste materials
- Fiber reinforced polymers
- Curing compounds
- Nano-materials in infrastructure projects
- Girder bridges with superior structural performance
- Road and bridge barrier design
- Arch bridges, suspension, and cable-stayed bridges
- Bridge construction systems
- Value engineering

CITC-11 International Scientific Review Committee

We would like to express our sincere gratitude to the members of the International Scientific Committee, who participated in the review process for the CITC-11:

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-A Special Thank You to Our Sponsor-

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RICS is the global professional body promoting and enforcing the highest international standards in the valuation, management and development of land, real estate, construction and infrastructure.

With offices covering the major political and financial centers of the world, RICS's market presence means they are ideally placed to influence policy and embed standards at a national level.

RICS works at a cross-governmental level, delivering a single, international standard that will support a safe and vibrant marketplace in land, real estate, construction and infrastructure, for the benefit of all.

RICS accredit over 130,000 qualified and trainee professionals and any individual or firm registered with RICS is subject to their quality assurance. RICS is proud of their reputation and guards it fiercely, so clients who work with RICS's registered professionals can have confidence in the quality and ethics of the services they receive.

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CIOB is the world's largest and most influential professional body for construction management and leadership. CIOB has a Royal Charter to promote the science and practice of building and construction for the benefit of society, and CIOB has been doing that since 1834. Their members work worldwide in the development, conservation and improvement of the built environment.

CIOB accredits university degrees, educational courses and training. Their professional and vocational qualifications are a mark of the highest levels of competence and professionalism, providing assurance to clients and other professionals procuring built assets.

CIOB

THE CHARTERED INSTITUTE OF BUILDING

Information obtained from the CIOB website: https://www.ciob.org/

Keynote Speaker

Professor Geoff Layer

Geoff Layer has been Vice-Chancellor of the University of Wolverhampton since August 2011. Before joining Wolverhampton he was Deputy Vice-Chancellor (Academic) at the University of Bradford and prior to that, after years of teaching and researching in Sheffield Business School, he became the Professor of Lifelong Learning in 1996 and Head of Access and Guidance at Sheffield Hallam University.

Geoff has always been active regionally, nationally and internationally. He is a Board Member of Advance HE, the Black Country Local Enterprise Partnership and the Black Country Chamber of Commerce. He was Chair of the Department for Education's Disabled Students Sector Leadership Group and is currently Chair of the Student Loans Company Stakeholder Forum. He is also a governor for the Telford College Corporation and a Trustee of the Universities Association for Lifelong Learning.

Between 2000 and 2006 he was the Director of Action on Access, an agency established to advise HEFCE on its Widening Participation Strategy. He was also Director of the HEFCE Innovations Co-ordination Team from 2000-2002 and has researched and published widely on Inclusive Education.

He is a Fellow of the Royal Society of Arts, a Principal Fellow of the Higher Education Academy, A Fellow of Leeds College of Music and was awarded the OBE for services to Higher Education in 2003.

Professor Nazira Karodia

Professor Nazira Karodia is Dean of the Faculty of Science & Engineering at the University of Wolverhampton and Professor of Science Education. Nazira's interests are diverse and include chemistry teaching and research in sustainable chemistry, school-HE transition, student engagement; the promotion of STEM across the education spectrum; and gender in science. She has published widely and supervises research students in chemistry, gender and science education.

After her undergraduate studies at the University of Natal, South Africa, she moved, in 1992, to the UK to take up PhD studies in Chemistry at the University of St Andrews, Scotland. She held post-doctoral fellowships at the Centre for Heterocyclic Chemistry, University of Florida, and with the catalysis group at the University St Andrews. Nazira was appointed as Lecturer at the University of Bradford in 1999. There her role morphed from teaching and research in Chemistry to Associate Dean, an active role in student recruitment and extending and enabling university opportunity to a wider group of students. She was Director of STEM at Bradford and led the regional spoke of a national initiative to promote STEM education.

In 2015 Nazira moved to the University of Wolverhampton as a Professor of Science Education; she is currently Dean of Faculty of Science & Engineering. She is a member of the RSC's Science, Education, and Industry Board, the RSC's Outreach Working Group, the Institute of Physics Schools Outreach Support Advisory Group. She is a Fellow of the RSC and one of its "175 Faces of Chemistry."

Professor Richard Burt

Professor Richard Burt trained and qualified as a Chartered Building Surveyor in the UK. He holds a Masters degree in Construction Management and a Ph.D. in Architecture from Texas A&M University. He is currently the McWhorter Endowed Chair & Head of the McWhorter School of Building Science at Auburn University in Alabama. His expertise is in construction history and the survey and documentation of historic buildings. He has worked on several building documentation projects in the US and France. He has published in numerous journals and conference proceedings and was a principal investigator in a multi-year federally funded project to investigate the building remains at the historic D Day landing site at Pointe du Hoc in Normandy.

He served as the chair of an American Council for Construction Education task force to develop learning outcomes-based standards for construction education and in this capacity he conducted data gathering workshops in conjunction with the Associated General Contractors of America. He currently serves on the Board of Directors of the AGC Education and Research Foundation and the Board of Trustees of the American Council for Construction Education. Dr. Burt also serves as the co-coordinator of the International Council for Building (CIB) Working Group WG089 – Education in the Built Environment in this capacity he has organized workshops and paper sessions at conferences in England, Canada, United States, Finland and Australia.

Construction Management Education – A Historical Snapshot from both sides of the Atlantic

Abstract: What is the future for construction education? That was the original title for this keynote address. In making predictions about the future, it is important to understand what has happened in the past and how that has shaped the current environment. The early history of construction education particularly in the education of construction managers in the United Kingdom and the United States has not been formerly documented. The second world war and the anticipated reconstruction programs on both sides of the Atlantic led to a focus on planning for educating managers for the industry. In the United Kingdom various government reports with industry participation led to the majority of construction managers obtaining their education while in employment through part-time education at technical colleges. Up until the mid 1960's there are minimal opportunities for students in the UK to study for a degree in "Building". In the United States the situation is somewhat different with degree courses in subjects such as "Building Construction" and "Architectural Engineering" being offered at several universities before the second world war. The anticipated construction activity after cessation of hostilities led to a growth in programs with an emphasis on "Light Construction" in anticipation of the anticipated need for housing. A significant contribution to the establishment of these programs was made by Arthur A.Hood of the Johns-Manville company who served on a wartime government committee. An understanding of the early history of construction education should allow us to better understand the current situation and make more informed decisions about the future.

Irtishad Ahmad

Irtishad Ahmad has more than 30 years of experience in teaching, research and curricula development in civil engineering and construction management. Prior to joining AUS, he taught at Florida International University, North Dakota State University, University of Cincinnati and Bangladesh University of Engineering and Technology.

In 2016, American Institute of Constructors awarded Dr. Ahmad the prestigious W.A. Klinger Construction Education Award. He has co-authored the book Quantitative Techniques for Decision Making in Construction. He served as the Editor-in-Chief of the Journal of Management in Engineering, published by the American Society of Civil Engineers (ASCE) from 2002 to 2008. He is a registered professional engineer and an elected Fellow of ASCE.

Digital Technology and Integration in Construction: The UAE Context

Irtishad Ahmad[1] and Sameh El-Sayegh[1]
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irahmad@aus.edu

Abstract. Traditionally construction is a fragmented industry too slow in adopting new technology. As a result, construction sector productivity continues to remain stagnant. Digital technology offers a great opportunity to improve productivity by integrating many entities and functions in construction. The paper argues that integration can be achived to a large extent with proper adoption of digital technology. Technology's transformational role in construction needs to be reconginzed and harnessed by the stakeholders. The transformatons and potentials are evidenced in the construction sector of UAE, where the government is taking a proactive role in facilitating adoption of digital technologies, such as Blockchain. A conceptual model that explains the push/pull relationship between technology and integration is presented in the paper. The main conclusion of the paper is that the construction industry at all levels - firm, industry and government – must take proactive actions to foster and facilitate integration in its processes by adopting technology.

Mohan M. Kumaraswamy

Prof. Mohan Kumaraswamy is now an Honorary Professor of The University of Hong Kong, having been based there from 1992 to 2013. He is also an Honorary Professor of the University of Moratuwa; and has previously been a Visiting Professor at the National University of Singapore and at Curtin University, Australia; and an Adjunct Chair Professor at IIT Madras, India.

His Civil Engineering Degree is from Sri Lanka, while his M.Sc., Ph.D. and D.Sc. degrees are from Loughborough University, UK. Before joining academia, he worked on designs, construction and project management, and led consultancies funded by ILO, UNDP and World Bank. He also served as a Consultant to the World Bank in 2014. He is also an Adjudicator and Arbitrator.

He has contributed to many professional bodies e.g., as: the first Sri Lanka representative of CIOB (Chartered Institute of Building, UK) until 1992; Vice-Chairman of CIOB Hong Kong in 1996-97; Chairman of the Civil Division of Hong Kong Institution of Engineers in 1997-98. He is now a member of the Accreditation Board of the Institution of Engineers Sri Lanka.

He is the Founding Director of the 'Centre for Innovation in Construction & Infrastructure Development' (CICID) which he launched in Hong Kong in 2002. His international contributions include those as Co-ordinator of the international CIB Working Commission on 'Public Private Partnership'; and as the Editor-in-Chief of the 'Built Environment Project and Asset Management' journal.

UNSTABLE LINKS and **UNTAPPED SYNERGIES**
between **Academia, Construction Industry, Government** *&* **Society at large**

Prof. Mohan Kumaraswamy

The University of Hong Kong & The University of Moratuwa

Much has been said about the imperative for deep collaboration between academia and industry in formulating and jointly pursuing R&D agendas, particularly in our domain of construction engineering and management. However, initiating and sustaining meaningful collaboration, yielding significant gains, has often proved difficult. Therefore, potential synergies from such latent linkages remain largely untapped. One approach to strengthen existing weak links and/or establish and nurture new linkages, has been to catalyze them with Governmental inputs, such as seed-funding and/or incentives including tax concessions. It is shown how such approaches could in turn be reinforced and sustained by engaging the end-users of construction outputs from the outset, while also factoring in the long-term net benefits and value additions to society at large. From another perspective, but along similar lines, it is shown how Government funding of academia could be more productive in helping target overall societal goals, by linking relevant representatives to develop and aim at long-term national developmental goals. From a third perspective, it is shown how Public-Private Partnerships that develop public built infrastructure need to be strengthened and stabilized by focusing on life-cycle value based on end-user needs. For this, it is suggested that relevant representatives of 'People' should be embedded in Public-Private-People-Partnerships (4P), through 'framework agreements' in suitable projects, albeit with necessary safeguards to minimise potential downsides. The above suggestions, with examples, are presented in the context of a quest for 'breakthrough solutions' in developing operating and sustaining 'smart, sustainable and best value' built infrastructure for society at large.

Peter Bolton-King

Peter Bolton-King (FRICS FNAEA FIRMP) is the Global Director of Professionalism and Ethics at the Royal Institution of Chartered Surveyors (RICS), whom he joined in April 2012. Peter started work in 1973 with a leading firm in the UK. After qualifying as a Chartered Surveyor, he became the firm's youngest ever partner.

In 2003 Peter was appointed Group Chief Executive of the National Federation of Property Professionals in the UK, a post he held for 10 years before RICS.

Peter currently holds a number of UK and Global Industry appointments on behalf of RICS. He is also a 'Senior Visiting Fellow" at a UK University. He continues to influence Governments in the UK and globally for better standards in the industry and is Chair of the International Ethics Standards Coalition.

A large part of Peter's current workload involves leading a project which is looking to understand the non-technical risks to the reputation of RICS professionals.

What does being a professional mean in this day and age?

Abstract:

The real estate profession, whether that be Land, Construction, Infrastructure, Property or related professionals is under pressure. To many, professionalism is a word that over the years has been dumbed down.

Peter will consider this issue and share some recent RICS research.

It is equally clear that our industry continues to become increasingly international. Many work in worldwide firms and we deal with large global end users. Investors are often considering property and development schemes around the world. As our work changes and grows, so must our approach to developing and reinforcing professional ethics.

Peter will explain how global standards help to bring much needed transparency and re-assurance?

Andrea Rutledge, CAE
President & CEO
Construction Management Association of America

Association executive with twenty-eight years' experience in association leadership, government, and higher education with a significant record of achievement as an innovative executive, strategic thinker, collaborative leader, and passionate advocate.

Before becoming President and CEO of CMAA, Andrea Rutledge spent 10 years as Executive Director of the National Architectural Accrediting Board, the sole agency authorized to accredit professional degree programs in architecture. Previously, she was Managing Director/Alliances at the American Institute of Architects.

About CMAA

The Construction Management Association of America is an industry association dedicated to the practice of professional construction management. CMAA represents more than 16,000 members including federal/state/local government and private sector owners, construction consultants, technology suppliers, academia, and legal organizations all with a common goal: to improve our nation's infrastructure.

History of CMAA

CMAA was formed in 1982 to establish a set of professional standards for managing capital construction projects. One of CMAA's goals is to help the construction management profession further develop its own unique identity within the architecture, engineering, and construction industries. The organization's mission is to promote the profession of construction management and the use of qualified construction managers on capital projects and programs. For additional information, visit www.cmaanet.org.

Workshop
Managing Risks in Multi-Stakeholders' Projects

Description: This workshop highlights main risks arising in managing construction contracts of multi-stakeholders. Key stakeholders in most common projects are three or four parties: Owner, Consultant/PM and Contractor. In multi-stakeholder projects, you may have around ten key stakeholders: Owner, Sponsor, Regulator, End User, Designer, Supervision Consultant, Project Manager, Main Contractor, Supplier/Vendor and other Specialized Sub-Contractor. Dealing with those stakeholders of different –and sometimes contradicting- perspectives, requirements, interests and expectations would create high impact project risk/issues. This workshop presents analytical techniques for identifying, classifying and engaging project stakeholders for the best outcomes in achieving project objectives. It will also identify main risks/issues and proposes different strategies for mitigating them.

Topics: Overview of stakeholder management – Analysis, classification and engagement of stakeholders – Contradicting stakeholders' requirements – Main risks/issues related to stakeholders – mitigation strategies for project risks.

Date: Sept. 10, 2019 15:45-17:15
Session: 6
Location: Lecture Hall

Speaker: Dr. Mohamed El Agroudy, PhD, CCT, PMP, RMP, TRC, MCIArb, M.ASCE, PM Consultant and Visiting Professor, The American University in Cairo, Egypt.

Certificate:
All participants will receive 2.0 Professional Development Hours (PDH) certificate.

Speaker: Dr. Mohamed El Agroudy
PhD, CCT, PMP, RMP, TRC, MCIArb, M.ASCE

Dr. Mohamed El Agroudy has decades of experience in construction engineering and management. He is a Certified Corporate Trainer (CCT), a Project Management Professional (PMP), a Risk Management Professional (RMP), a Transnational Referral Certified (TRC) and an International Arbitrator. He had his BSc in civil/construction engineering, a Masters in contracts and a PhD in contracts and risk management. He is teaching Contracts/Risk Management at the American University in Cairo. He is a project management consultant for mega projects in the Middle East. Dr. El Agroudy has trained many professionals around the globe and has performed a lot of workshops and keynote speeches in more than 25 countries. His areas of expertize include: Contracts, Risk and Facility Management. He is an active member of Project Management Institute (PMI), International Facility Management Association (IFMA), Chartered Institute of Arbitrators (CIArb), American Society of Civil Engineers (ASCE), and board member of Green Building chapter at Saudi Council of Engineers (SCE).

Contents

Peer Reviewed Paper Abstracts

(Paper, ID 2)

Construction Project Delivery in Nigeria

Dubem Ikediashi[1], and Godfrey Udo[2]

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[2] Department of Estate Management, Faculty of Environmental Studies, University of Uyo, Uyo, Nigeria
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Abstract. Effective management of inventories has been widely acclaimed as an important panacea for sustainable construction project delivery. This paper evaluates inventory management practices in the Nigerian construction industry. To achieve this, the specific objectives are to; (1) assess inventory management practices in the construction industry and (2) explore the influence of inventory management on project delivery in Nigeria. A structured questionnaire was distributed to 110 construction companies in three strategic cities of Lagos, Abuja and Port Harcourt using purposive and stratified sampling techniques. Ninety (90) valid responses were retrieved giving a response rate of 82%. Data collected were analysed using descriptive and inferential statistics. Findings reveal that materials requirement planning (MRP) with a mean score of 3.972 was the top ranked technique for construction project management in the Nigeria. This is closely followed by warehousing management (WM) (3.961) at the second, first in first out (FIFO) (3.880) at the third, Findings also reveal that the level of use of all the three inventory management techniques had significant influence on project delivery time and cost but not on quality. The paper recommends that contractors and industry associations should embrace the concept of inventory management to improve efficiency in terms of growth, turnover and sustainability. Besides, stakeholders should carry out advocacy and sensitisation to improve level of awareness while educational construction institutions should update their curriculum to incorporate sustainable and more innovative technologies into inventory management.

Keywords: Materials management, Project performance, Construction industry, Nigeria

(Paper, ID 6)

Overview of Concrete Durability Evaluation using Electrical Resistivity

Amin Akhnoukh[1]
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Abstract. The current quality control procedures for concrete production focus mainly on concrete compressive strength. Despite of its relevance to concrete performance, compressive strength testing is poorly correlated to the long term performance of concrete mixes, including the concrete ability to withstand chloride and sulfate attacks, and the concrete capability of protecting the steel bars and prestress strands against corrosion.
This research presents an overview to the use of electrical resistivity testing technique as an alternative quality control procedure that is currently used in assessment of concrete long-term performance. Electrical resistivity testing conducted through surface resistivity (SR) and bulk resistivity depends on measuring the concrete porosity and pores connectivity within hardened concrete samples. The final resistivity measured in ohm-meter is inversly proportional to the pores ratio and pores connectivity. Thus, a higher resistivity is a good indicator to minimal and disconnected pores formation within the concrete, which leads to a better future performance of hardened concrete structural elements. The outcome of electrical resistivity is currently used by several state departments of transportation (DoTs) to improve concrete mix designs, and minimize the potential need to maintenace activities during concrete projects life span.

Keywords: Durability, Resistivity, Conductivity, Corrosion, Chloride Diffusion

(Paper, ID 11)

An Assessment Tool to Measure the Lean Construction Maturity Level

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Abstract. The past two decades have witnessed a rapid increase in construction projects within developing countries in the Middle Eastern Gulf region. Despite this, construction companies still face many challenges, including completing projects on time and within budgets. The negative impact of these challenges has been confirmed through (1) data collected from documents concerning completed construction projects in which the author has been professionally involved; (2) the author's experience in the field of construction project management in the Middle East and risk management in particular; and (3) extensive study of the literature in this domain.
To that end, the objective of this study is to create a Lean Construction Assessment Tool. To achieve this objective, the research work (a) investigates the linkages between Lean and risk management; (b) reviews the concept of Lean and

its application to the construction industry in developing countries (c) analyses the barriers and success factors; and (d) identifies the benefits of Lean Construction within construction organizations in developing countries.
Among the main findings of this research is the lack of future strategic plans for the construction industry in terms of managing waste and risks in general and specifically in developing countries. It is hoped that the outcomes of this research study will have theoretical and practical significance for successful Lean implementation in construction organisations in developing countries.

Keywords: Developing Countries, Lean Construction, Mega-Construction, and Risk Management.

(Paper, ID 12)

Best Management Practices in Design, Construction, and Maintenance of Mechanical Systems in Data Centers

Prabha Sharma[1], Scott Kramer1[1], Junshan Liu[1]

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Abstract. This purpose of this research study is to evaluate the challenges faced during the project definition, design, construction, and maintenance phase of mechanical systems projects for new Data Centers or existing Data Centers. Construction industry professionals, design professionals, data center management and engineering personnel were surveyed. The survey questionnaire comprised of 27 questions and focused on the following themes: General information and respondent's area of knowledge and experience, Overall Management Challenges in Data Centers, Challenges specific to data center mechanical systems, standard management practices and processes employed in data center mechanical projects and recommendation and suggestions to arrive at best management practices in mechanical systems projects for data centers. The results of the survey were evaluated to arrive at best management practices to better assist in building reliable data centers.

Keywords: Data centers, mechanical systems, best management practices

(Paper, ID 13)

Building Commissioning: Do Cost Benefits Outweigh the Initial Investment for U.S. Army Corp of Engineers?

Amber Lanphere[1], Scott Kramer[1], and April Simons[1]

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Abstract. The research conducted in this study explored the various building commissioning processes currently implemented at the U.S. Army Corps of Engineers for building construction projects in order to determine if the benefits and cost avoidance outweigh the initial cost investment. Over recent years, the USACE has been experiencing some challenges with meeting scheduled beneficial occupancy dates (BOD) on several military construction projects. These issues have led to investigation and analysis efforts in order to determine the root cause for not meeting scheduled BODs. Many of the identified root causes could have been mitigated or eliminated early in the project if building commissioning had been properly implemented and administered with a qualified Commissioning Authority (CxA). This research study includes recommendations for implementing a consolidated, technically sound and detailed building commissioning specification. This should help reduce the cost of building commissioning by eliminating overlapping requirements.

Keywords: USACE, Building Commissioning, Cost, Specifications.

(Paper, ID 14)

Antecedents of Client Loyalty in the Construction Professional Services Sector: A Qualitative Study

Nick Williams[1], Dr Paul Hampton[1], Dr Nii Ankrah[1]and Dr Ezekiel Chinyio[1]

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Abstract. While a limited amount of research has focused on client loyalty in wider professional services, none has been carried out specifically in respect to construction professional services (CPS). A review of the wider professional service literature identified a number of key candidate loyalty antecedents. Thematic analysis was undertaken on semi-structured interview data obtained from twenty client and CPS supplier participants operating in the West Midlands (UK). The results were used to refine a literature-derived model of CPS client loyalty. Several modifications were made to themes and sub-themes in light of empirical data. The results obtained will form the basis for a future quantitative phase of research which will determine the extent to which the findings of this qualitative research generalise to the wider population.

Keywords Construction professional service firm; CPS; loyalty.

(Paper, ID 15)

Reducing Our Energy Usage and Reliance to Mechanical Air Conditioning through Passive Cooling: Can It Be Done at Home Today?

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Abstract. Today more houses are being built to rely solely on air conditioning as the only means of cooling a home. This research study explored methods available that may help minimize energy consumption and reduce reliance on mechanical cooling through passive cooling while focusing on retrofit options for existing residential buildings and energy saving considerations for new residential construction in the United States of America. The data of this research was collected through literature review, a combination of an online survey and interviews on individuals' experiences with air conditioning, and an interview with an electrical energy provider managing weatherization home improvements.

Keywords: Air Conditioning, Energy, Insulation, Natural Ventilation, Passive Cooling, Residential Construction.

(Paper, ID 16)

Enhancing Innovativeness in the Construction Sector: A System Dynamics Analysis

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Abstract. The construction industry has often been criticised for its lack of innovation and commitment to R&D. Using a systems approach, this study examined a number of construction innovation system scenarios and policy interventions within the context of four future plausible Russian construction industry transition scenarios. A system dynamics (SD) model was developed to incorporate the main actors of the construction innovation process, namely, industry, government and academia. The SD model provided insight into the complexity and inherent dynamics of innovation processes caused by multiple feedback loops, nonlinearity, and time delays in decision-making. The SD model also addressed the challenges of transforming Russia's construction industry into a highly developed sector by providing an understanding of how government policies and supportive programs could encourage industrialists to innovate, promote research and transfer technology. The transition scenarios were developed by considering the variation of two factors driving innovation in the construction sector, namely: (1) the conditions and level of government financial support; and (2) demand for innovation related to market expectations, largely dictated by traditional versus progressive procurement processes. One key finding was that the Russian construction industry preferences imitation-oriented innovation development.

Keywords: Construction Innovation, System Dnamics Modelling, Transition Scenarios.

(Paper, ID 17)

Urban Planning in the Context of Seatropolis City through the Public-Private Partnership Scheme

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Abstract. The rapid demand for goods shipping and increasing role of sea transportation services make countries that have sea territory developed sea transportation infrastructure. They do not only develop for transportation, exploitation of marine products, and tourism, but also make seafront areas as the potential development of the new city of Seatropolis. This research used the qualitative and quantitative method through literature studies to identify parameters as a minimum requirement for the development of marine areas that can support the development of advanced new cities. After that, through a case study on the country of Indonesia which is a maritime country with the largest area of the sea obtaining the size of the initial investment cost of a city with the concept of seatropolis. In the final stage of this research was in-depth interviews for validating the results of data analysis results. The results of the case study identify potentials in developing eco-town in the coastal area such as commercial area, residential, power plant, and industries through sustainable development concept. The total initial cost to develop seatropolis cities was US$ 1,974,070,053.85. This research observation divided the operational costs into three phases of construction development. Each phase of 2023, 2025, 2027 consisted of US$ 18,888,781.62, US$ 33,872,403.81, and US$ 51,974,650.82. The government should include in the

financing scheme for the initial cost of 59.38% and invest in operation and maintenance around 31.74% with obtained revenue of 33.96%. This scheme generates optimum IRR of about 15.41%.

Keywords: Port-City, Public-Private Partnerships, Urban Development, Life Cycle Cost.

(Paper, ID 18)

Exploring the Working Conditions of People in Construction

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Abstract. The working condition concept is an essential topic in the construction industry where management must provide a workplace that is free from hazards and risks that might cause accidents. Site management, in particular, must maintain working conditions that are safe and healthy for the workforce. This is however not the case in reality as injuries and fatalities are often linked to working condition factors in construction. This paper thus reports on the factors causing poor working conditions on construction sites in the central region of South Africa. This study adopted an ethnographic research approach to conduct 12 semi-structured interviews. From the findings, it was discovered that most of the construction workers are exposed to the dangerous working environment, which may harm their health, safety and well-being (HSW). The paper further highlights the lack of proper housekeeping as an area of serious concern in this context. The influence of lack of housekeeping frequently contributes to injuries and accidents in the construction sites. Therefore, a measure to improve housekeeping and other working condition factors should be deployed on site with management tools such as the 5S (Sort, Set, Shine, Standardize, and Sustain).

Keywords: Construction, housekeeping, working conditions, South Africa.

(Paper, ID 20)

Construction and Demolition Waste Management on Construction Sites in Kazakhstan

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Abstract. The rapid development of the construction industry in Kazakhstan has led to the formation of construction and demolition (C&D) waste which significantly affects the environment. C&D waste contains hazardous materials in significant quantities which have an adverse effect on the public health and the environment. It is essential to reduce C&D waste. This paper focuses on the determination of appropriate C&D waste management strategies. C&D waste minimization techniques such as reducing, reusing, recycling, bioremediation, composting, and incineration were identified and explored through the literature review. A questionnaire survey was conducted to investigate current C&D waste management practices on construction sites in Kazakhstan. The questionnaire survey was sent to 270 respondents in 11 companies in different cities of Kazakhstan. The response rate of the questionnaire was about 93%. It was found that recycling was the most appropriate method for waste minimization on construction sites in Kazakhstan. The information which came from the questionnaire survey helped to understand how to apply the recycling methodology on construction sites with benefits and drawbacks. Consequently, after identifying a proper waste minimization method, it is necessary to prepare an adequate site waste management plan.

Keywords: Waste Management, Construction and Demolition Waste, Kazakhstan.

(Paper, ID 21)

General Contractor Knowledge of Infection Control Requirements on Hospital Renovation Construction Projects

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Abstract. Healthcare associated infections (HAI) are common afflictions for hospital patients. Construction-related renovation projects are abundant at hospitals in the United States, the results of which have the potential to cause HAI. Hospital-accrediting firms such as the Joint Commission have a strict focus on ensuring that infection control risk management assessments are completed by hospital owners prior to the start of renovation projects. Fifty-six hospital renovation subject matter experts from general contracting firms in the southeastern United States completed a survey to discern their knowledge of and experience with infection control on hospital renovation projects. The survey results showed that (1) general contracting firms place a focus on training their personnel in infection control, as general contractors are most often responsible for ensuring that infection control measures are adhered to, (2) there are an adequate amount of products on

the market for infection control, which are utlized on almost every renovation project and (3) field operatives (i.e., the individuals that actually complete the work) should receive more training on infection control. Future research should seek to expand this study into geographic regions outside of the southeastern United States, and to discern how more training of field operatives can be implemented.

Keywords: Healthcare construction, Infection control

(Paper, ID 22)

Building Information Modelling in Transport Infrastructure Sector

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Abstract. The Building Information Model concepts includes a range of IT tools supporting the collaborative processes in an organisation. This approach allows all stakeholders to have an integrated system in which editing and retrieving up to date information on shared models will become easier changing the businesses processes. This paper will be presenting a review of research on the Building Information Model in practice. The Building Information Model has been around for some time and is becoming more popular as of its mandate in the UK back in April 2016. This research is based on case studies on BIM in practice in the transport infrastructure sector. The methodology for this research is a case study on a Tier 1 contractor in the UK who are using BIM as one of their processes. A brief overview of BIM will be explained and the key findings in the research will be highlighted identifying the business value of BIM, the results will demonstrate how BIM is being practiced within the organisation and to improve design management, the challenges with the implementation of the new processes will be outlined, this paper will also show how the construction company have utilised the adoption of BIM to mitigate and manage communication issues within their projects. Research has shown that the key communication and management problems such as loss of documentation, poor communication and quality can be mitigated with the use of BIM. Finding out these challenges will allow the issues found along with the potential of BIM to be outlined and allows the conclusion that BIM is the future of construction.

Keywords: Building Information Model, Communication, Engineering and Construction, Collaboration, Infrastructure.

(Paper, ID 23)

A Factor Analysis of Transportation Infrastructure Feasibility Study Factors: A Study among Built Environment Professionals in South Africa

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Abstract. Feasibility studies conducted at the initiation stage of transportation infrastructure projects inform decision-making regarding the proposed project's development. However, non-comprehensive feasibility studies lead to project failure at the operational stage. This study therefore investigated the critical factors that should be incorporated in a comprehensive feasibility study in order to make reliable investment decisions, which will in turn affect performance at a later stage. Empirical data collected from 132 built environment professionals in South Africa, were analysed to output descriptive and inferential statistics. The inferential statistics entailed factor analysis. Outputs were common factors and the minimum number of variables that contributed the most variance in the data set. Findings revealed that a six-factor structure including methods of appraisal, finance availability and source, user needs, local environment, available data and strategic support. By establishing critical factors to consider during the planning of infrastructure to ensure that a comprehensive feasibility study is achieved, the current study provides valuable evidence for transportation infrastructure stakeholders to make informed and reliable decisions about the worthwhileness of the projects they intend to invest in.

Keywords: Feasibility studies, Infrastructure, South Africa, Sustainability, Transportation

(Paper, ID 25)

Identification of critical factors for Construction Megaprojects Success (CMS)

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Abstract. The worldwide growth of construction megaprojects has triggered an increasing number of academic publications in the past few decades. Therefore, this paper aims to systematically review studies on the critical success factors (CSFs) to identify the CSFs for construction megaprojects from academic journals between 2000 and 2018. The research results indicated an increasing research interest in the investigation of critical factors for CMS since 2000. Meanwhile, based on the number of 27 journal articles, a total of 33 CSFs were identified eventually and the top five were adequate resource availability, partnering/relationships with key stakeholders, adequate communication and coordination among related parties, public support or acceptance, and clear strategic vision. A checklist of CSFs for CMS was developed and could render new insight for researchers and practitioners to conduct further studies and enhance megaproject management in practice. Moreover, the results would also enrich the theory of megaproject management.

Keywords: Critical Success Factors, Construction megaprojects, Megaproject management, Project success.

(Paper, ID 26)

Investigating the Criticalities of Corruption Forms in Infrastructure Procurement in the Developing Regions

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Abstract. This study examines the criticalities of the forms of corruption in infrastructure project procurement. The study employed non-probabilistic sampling techniques to reach 62 experts actively involved in the processes of infrastructure procurement within the context of developing regions. The variables captured under the constructs of the forms of corruption were identified via the review of pertinent literature. They were empirically examined after being evaluated by the experts involved in the survey. A total of twenty-seven variables were identified and examined. From the analysis, bribery, lobbying, and price-fixing were identified to be the most critical forms within the developing context. This study intends to contribute to a deepened understanding of corruption-related attributes in construction project management. It also offers valuable information to practitioners, particularly from the developing regions on the critical forms of corrupt practices within the different stages of the procurement process and the need to mitigate their incidence and widespread strategically based on informed decisions.

Keywords: Corruption; Infrastructure, Construction, Project Management, Developing Countries.

(Paper, ID 27)

Benchmarking Project Manager's Compensation

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Abstract. The US construction industry has faced fluctuating economical periods in the 21st century. In 2008, the industry decline was so extreme that it not only affected the construction industry but also the entire economy of the nation. Those fluctuations affected many aspects of the construction industry, compensation rates were one of the most impacted areas. With the construction industry's fragile and highly connected nature to economic trends, it became harder to determine remunerations of the workers in the industry. This study focuses specifically on construction project managers' (PM's) compensation. The objective of this study was to benchmark project manager's compensation in general contracting firms. The intended audience are GCs or human resource departments of general contracting firms. The data was collected from privately-held Georgia-based general contracting companies in a survey conducted in 2016. The study analyzed PM's compensation rates alongside industry and market statistics to identify correlating trends. The results of the study add to the field of business and management practices in construction. The results provided patterns of compensation for PMs in the construction industry. The study concludes that PM compensation is not determined only by the size of an organization, but it depends on a set of organization specific factors including gross revenue earnings, and experience (age).

Keywords: PM Compensation, benchmarking, Project Manager, Construction Industry, General Contracting.

(Paper, ID 28)

Are the Ageing Workforce Satisfied with the Construction Work Environment?

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Abstract. The construction industry is experiencing a shortage of workforce and skill gap due to the significant reduction in the younger workers entering the construction industry compared to the exponential number of retiring workers. Providing ageing workforce with a satisfactory construction work environment (CWE) can be one of the ways to encourage them to remain in the construction industry. Therefore, this study aims to assess the level of satisfaction of the ageing workers with the CWE. The study adopted a quantitative approach and data was sourced from older construction workers in Edinburgh, Scotland using a questionnaire survey. Factor analysis and mean score analysis were employed to assess the older workers level of satisfaction with the CWE. The study identified five components of the CWE termed as organisational-psychological environment, physical environment, functional environment, policies and practices environment and auxiliary environment. The older workers were most satisfied with the functional environment, followed by the auxiliary environment, policies and practices environment, physical environment and lastly, organisational-psychological environment. The study recommended that the construction industry put in more effort in making the CWE very satisfying to all workers especially the ageing workforce. A very satisfying CWE should compensate and amend the losses accompanying ageing. The authors encourage future studies to explore the relationship between the level of satisfaction with the CWE and the quality of life of the ageing workforce.

Keywords: Ageing, Older Workforce, Construction Work Environment, Construction Industry.

(Paper, ID 30)

Image Based Inspection and Monitoring of Buildings

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Abstract. The rapid evolution of cameras and drones in the past few years has paved a way for image-based inspection and monitoring of buildings and other structures. This study presents a framework for the development of an automated image-based building inspection and monitoring system. Images acquired from multiple locations of the building can be used to construct a 3D model or a 2D elevation view which is then matched to its BIM (Building Information Modeling) model. The image of each structural member and its dimensions obtained from the matched model is fed to an image processing algorithm which detects cracks in concrete surfaces and measures crack parameters. A machine learning algorithm trained on several synthetic crack scenarios automatically predicts severity of each crack and the corrective action to be taken for maintenance. The detected cracks are color coded and the severity is mapped back to the BIM model so that the current structural state can be effectively visualized. Using several images of real structural members, it is demonstrated that the crack analysis system shows fairly accurate results. Apart from being a smart and convenient tool for structural inspection, the developed framework also results in better operations, planning and facility management.

Keywords: Structural Inspection and Monitoring, Drones, Image Processing, Building Information Modeling, Machine Learning.

(Paper, ID 32)

Risk Management in Procurement of Blue-Green Roofs – Supplier Perspective

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Abstract. Blue-green roofs are increasingly adopted as a measure to reduce risk related to stormwater events. However, as a novel building element they present elements of uncertainty in themselves. The integrity of the roof is vitally important to long-term building operation, it is

therefore important to understand the extent and impacts of this uncertainty. Documents from building product suppliers are investigated to chart how technical uncertainty and quality risk is managed regarding blue-green roofs. The main form of uncertainty management comes in the form of performance declarations, specifying the operating limits of the products. If a failure occurs, the supplier seeks to be able to document that the quality of the product was not at fault. The processes by which product performance is documented may be very challenging for anybody but the suppliers themselves to gain insight into.

Keywords: Blue-Green Roof, Risk, Uncertainty Management, Supplier Perspective, Quality

(Paper, ID 33)

BIM Awareness: The Kenyan and UK Scenarios.

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Abstract. In the global context, Building Information Modeling (BIM) is a catalytic agent for innovation, productivity and efficiency in the construction industry. BIM adoption in Kenya is rare whereas the volume of construction is poised to increase and the gains that can be achieved via its use could be enormous. In the UK, all projects are to use a minimum of level two BIM to enhance collaboration and coordination with visual aids and a common data environment that enhances communication with the project proponents and all the other stakeholders. The main aim of this study was to determine the BIM gaps in terms of awareness and use in order to form a basis for the development of future adoption strategies in infrastructure projects in Kenya. The research was carried out in Nairobi and London. The study was designed as a survey that started with a desk study followed by semi structured interviews. Analysis of the data was done using content analysis. The findings identify significant differences in BIM awareness and use, the influence of which could provide insight for the developed and developing countries. The state of research, training and practice pertaining to BIM in Kenya remains largely undocumented whereas in the UK, there are national level initiatives driving its adoption. This paper concludes that BIM success is dependent on close collaboration between the client, consultants, contractors and suppliers along with the establishment of a well-developed BIM protocol and the lessons learnt from the UK can easily be used by Kenya as it embarks on its BIM journey for an efficient and harmonious working environment in this era of globalization.

Keywords: BIM, Infrastructure Projects, Collaboration, Project Stakeholders, Sustainable Development.

(Paper, ID 34)

Urban Underground Future: The Potential of Subsurface Utilization in Nairobi, Kenya.

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Abstract. Rapid urbanization in Nairobi city is exerting pressure on the existing infrastructure and resources such as parking areas, the natural environment, fresh water supplies, roads, sewerage networks, communication lines, power lines and the overall quality of life of city dwellers. Whilst such association is vital, the city needs a new frontier that could provide significant contribution to future spatial requirements as an essential part of improving the quality of the urban environment. Nairobi has long enjoyed being a hub of finance and culture in the East African region. It has high land values, clear and coherent legislation for surface solutions but lacks clear rules and standards for underground construction. The main aim of this study was to identify the main problems risking both the functionality and quality of life in Nairobi city and to explore the various approaches to development, planning, geology, policies and projects being delivered and considered globally focusing on the need for good and professional planning of underground space. The research was carried out in Nairobi. The study was designed as a survey that started with a desk study followed by semi structured interviews using an interview schedule. The findings show that underground space provides a strategic solution by providing an additional spatial and service layer for transportation and utility infrastructure freeing up surface space which can be used more efficiently and effectively. This has the potential to improve accessibility, safety, the competitiveness of cities and the overall quality of life of the city dwellers. However, this comes at huge initial costs but lower lifecycle costs. This paper concludes that underground space can contribute to making the city sustainable, more resilient and cope with rapid urbanization. The paper recommends that in the not too distant future, the implementation of underground facilities should be considered equally as valuable as surface solutions in Nairobi, Kenya.

Keywords: Urbanization, Underground Urbanism, Geology, Planning, Sustainable Development.

(Paper, ID 35)

Assessment of the Level of Awareness of Robotics and Construction Automation in South African

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Abstract. South African economy is dependent on infrastructural development, which plays a major role in the country's economy. The Construction Industry has shown a slow increase in the adaptation of robotics and construction automation hence it is facing construction accidents, poor quality of work, and sometime projects results in cost overrun of which accident occur as the results of low level of supervision on site. The study focused on assessing the level of awareness of robotics and construction automation in South Africa. The research was carried out using information from the literature review and findings obtained from the questionnaire to achieve the objective of the study. A sample of respondents were chosen to represent the entire population of the construction professional, questionnaires were distributed to relevant respondents including Architects, Quantity Surveyors, Project Managers, Construction Managers and Contractors as well as Civil Engineers and the analysis was based on the returned questionnaires. Data obtained were analysed and the study revealed that construction professionals are fully aware of robotics and construction automation in the South African construction industry. The study concluded by indicating that construction automation and robotics would have positive effects on the delivery of the construction project by increasing quality of the construction product, enhancing supervision, working conditions, cost effectiveness and it reduces construction accidents.

Keywords: Automation and Robotics, Building Information Modelling, Computer Aided Design, Computer Aided Manufacturing, Industrialised Building System.

(Paper, ID 36)

Challenges to the Implementation of Lean Construction Practices in the South African Construction Industry

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Abstract. Lean Construction (LC) aims at concentrating on improvement, reduction of waste, money value, focus of user, project quality management, supply management, and improved communications. LC helps in reducing waste of materials, effort and time which therefore generates maximum possible value and provides a cohesive supply chain that reduces lead time. The Construction Industry performance is affected by waste. Such wastes are measured in materials, resources, time, movement, production and creativity. Hence this study identifies the challenges of implementing LC practices in the South African construction industry (SACI). Data used for this paper were collected using well-structured questionnaire distributed to professionals within the SACI ranging from Quantity Surveyors, Architects, Civil Engineers, Project Manager, Construction Manager, and Construction Project Manager. Findings emanating from the study revealed that poor work culture among project partners ranked highest followed by lack of good policies, complexity of lean construction process, poor organization knowledge among others as the challenges facing the implementation of lean management in the SACI. It was concluded that the main significant aspect that lean construction evolves around is attitude, this, therefore, requires construction industry participants to have a complete attitude shift and practice lean construction on their every-day tasks.

Keywords: Construction Industry, Lean Construction, Project delivery, Construction waste.

(Paper, ID 37)

Effectiveness of Contractors' Competitive Bidding Strategies in the UAE Construction Industry

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Abstract. Contractors seek different competitive bidding strategies in order to increase their opportunity in winning projects. The United Arab Emirates (UAE) construction industry is competitive. Additionally, nowadays, UAE companies tend to expand globally, entering new international markets. Therefore, effective bidding strategies need to be implemented to compete profitably in the UAE and the international markets. The objective of this research is to identify the effective competitive bidding strategies for construction companies in the UAE and international markets. Common competitive bidding strategies were identified through review of related literature. A

questionnaire was then prepared and distributed to construction companies in the UAE. Sixty five surveys were completed and analysed. As a result, the top five effective strategies in the UAE market are lowest bid, value management, achieving a combination of price & performance, application of high technology, and public relations strategy. The top five effective strategies in international market are noted to be achieving a combination of price & performance, lowest bid, value management, application of high technology, and public relationship. The results are particularly useful for international contractors who want to enter the UAE construction market.

Keywords: Bidding Strategies, Construction Industry, UAE, International Construction.

(Paper, ID 38)

Objectives of Competitive Bidding in the UAE Construction Industry

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Abstract. Competitive bidding is one of the main methods for procuring construction work. Contractors compete based on bid prices where the lowest responsible bidder is selected. Competitive bidding is both costly and time-consuming without a guarantee of contract award. Therefore, contractors are selective on which projects to bid on. Contractors have several objectives from participating in the bidding process. The aim of this research is to identify and assess the key objectives of bidding in the UAE and internationally. The main objectives are identified through literature review. A questionnaire was used to get the perceptions of construction professionals in the UAE construction industry. Sixty five questionnaires were collected. The most common objectives for bidding in general are building a reputation with the client, followed by the company need of work and survival. The most common objective for bidding in the international market is to target an international market when its economy is expected to boom, followed by bidding internationally to gain advantage of the opportunity offered by global market. This paper sheds the light on some of the key practices of contractors in the UAE construction industry and may be beneficial to those international companies who wish to compete in the local market.

Keywords: Bidding, Construction Industry, UAE, International Construction.

(Paper, ID 39)

Physical and Mental Health of Construction Workers: A Worse Status?

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Abstract. A physical and mental health profile of construction workers is lacking in Hong Kong. This paper aims to compare the behavioural risk factors, biomedical risk factors and self-rated health status between construction workers and the general population. A basic medical examination and a questionnaire survey were administered at 117 construction sites December 2017 to March 2019. A total of 2,396 Chinese workers were included for analysis. The data of the general population were derived from the published papers and reports. The results showed that construction workers consumed less alcoholic beverages and more fruit-vegetable than the general population but had heavier smoking and consumed less milk products. Although construction workers tended to have less working hours per day than the general population, they had less rest days per month. In general, objective and subjective physical health of construction workers was worse than the general population. But female workers had better self-rated mental health. Gender-specific health programmes should be developed in future.

Keywords: Behavioural Risk Factors, Biomedical Risk Factors, Self-rated Health Status, Construction Workers, General Population.

(Paper, ID 40)

Developing a Sustainable Concrete using Ceramic Waste Powder

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Abstract. The change from a traditional utilization based society to a sustainable society is urgently needed because of the contamination of the natural environment, the

depletion of the natural resources and the reduced capacity of the final waste disposal arrangements. Concrete is regarded as an advanced and major construction material which needs continuous innovation and improvement to reduce environmental impact. In the future, the demand for concrete will be increasing with the increase in population. This article presents an experimental study of using ceramic waste as a limited replacement with cement in structural concrete. Ceramic waste deposit, on one side, poses a number of environmental challenges, ranging from air, water and soil contaminations but on another side, it has cementitious properties. Concrete mixtures with different percentage of ceramic waste powder were produced, tested and compared in terms of compressive strength. As a result, the maximum compressive strength achieved with a 30% ceramic waste. The purpose of this study was to examine the performance of cement concrete with different percentage of ceramic waste powder, it needs to be noted that such performance may be varied when the grade of cement or chemical composition of ceramic waste powder will be changed. The long-run performance (after 28 days) of such concrete and especially when used with reinforcement need to be investigated further.

Keywords: Concrete Technology & Manufacture, Pollution, Sustainability, Natural Resources.

(Paper, ID 41)

Life cycle costing for decision making in construction and demolition waste management: A critical review

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Abstract. Construction and demolition (C&D) waste poses many environmental issues. There are many issues due to C&D waste landfills and construction industry has to face many costs when managing C&D waste. Currently there are many research studies carried out focusing on the C&D waste management. Even the environmental impacts of C&D waste are significantly researched, there is a minimum focus on the economic impacts of C&D waste management. Therefore, this research study aims to review the research carried out in C&D waste management focusing on its life-cycle costs. VOSviewer was used to develop the bibliographic networks and analyse the literature. Researchers conducted searches separately and both in conjunction of these two research domains. Most of the C&D waste management research focused on recycling and recycled aggregates. There is a clear lack of research on costs and economic point of view on C&D waste management. Few studies on costs for C&D waste management merely presented cost comparisons for specific waste management plans. Research on economic evaluation and specifically on life-cycle costing perspective for in C&D waste management paradigm is highly desired. Recycling is highly regarded in C&D waste management research. However, the life-cycle perspective of the extended life of recycled material is rarely discussed. There is minimum research carried out on monetising social benefits of C&D waste management.

Keywords: Cost, Construction and demolition waste management, life-cycle cost.

(Paper, ID 42)

Quantitative Assessment of Resilient Safety Culture Model Using Relative Importance Index

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Abstract. Resilient safety culture (RSC) is a socio-technical safety system that is made up of the employee's capabilities as well the protocols and systems in an organization to deal with hazards. Oil and gas industry sites in Kuwait were chosen for this study. Both urban and rural sites were chosen to gauge the level of resilience in their respective safety cultures. Employees in remote sites experience high stress which may lead them to develop mental health disorders over time. High stress can also be caused due to loneliness of being aloof from the social circle and from an urban surroundings. Expatriates or employees in remote work sites experience greater stress at work due to these factors as compared to urban settings. Stress and mental illness have been identified to affect safety negatively. This, in turn, impacts on safety culture which is the focus of this paper. This study ranks constructs and indicators based on data analysis to show which constructs play important part in this case study.

Keywords: Safety Behaviour, Mental Health, Resilient Safety Culture, Remoteness

(Paper, ID 43)

Innovative vocational training for the Construction Industry

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Abstract. The advent of the 21st century have resulted in significant population growth across the major Australian cities. Currently, the state of Victoria is the fastest growing amongst Australian states and territories, recording the highest growth of 2.3% in 2017, with forecasts indicating a 50% increase of the state's current population over the next three decades. These demographic changes have necessitated higher demand for critical building and infrastructure services. However, there is endemic shortage of skilled labour across the entire construction industry, which could impact ongoing development and delivering of strategic infrastructure over the coming years. This occupational skills shortage has further economic implications by reducing productivity and delaying development and growth. The lack of investment in training in recent decades, the increase in rework, the decline in interest in site roles and the continued growth in the industry means that it is not well placed to deal with current requirements. This paper outlines the case for an alternative education method and presents an innovative framework to create transformation change for workforce training and skills development for the construction industry through the "Maker Immersion Project". The innovative project, funded by the state government, will developed a world-first fully deployable, technology enhanced education package that creates an immersive learning by blending traditional face-to-face training with Virtual Reality simulations.

Keywords: Construction, Skills shortage, Immersive education, Virtual Reality.

(Paper, ID 45)

Exploring the Current and Future States of Augmented Reality in the Construction Industry

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Abstract. In construction, adoption of advanced technologies has the potential to significantly improve the performance of projects. The construction industry has experienced a radical evolution as it entered the era of digital documentation and information exchange. Construction design began with drafting boards, then moved to Computer-Aided-Design, and finally to Building Information Modeling. At each stop along that journey, gains were made in information density and exchange. However, for all the progress made thus far, the paradox of designing the 3D in 2D space remains. As Industry 4.0 continues to evolve, it is imperative that construction firms seek, find, and adopt new technologies – both to remain competitive and to grow in the industry. Augmented reality (AR), a pillar of Industry 4.0, has the potential to transform the construction industry. This paper explores the current and potential future states of AR in construction. Might this technology gain momentum and take hold in construction, as it has done in other industries? To investigate this question, industry practitioners were surveyed. 128 responses were collected and analyzed to provide insight into the current and potential future states of AR in construction.

Keywords: Augmented Reality, Construction Industry, Current State, Future State.

(Paper, ID 46)

Modelling Correlations in Highway Construction Projects

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Abstract. The study examines the different types of correlations between the construction costs, times and cost/time of highway construction projects and quantified their impacts on the total cost and total time of different structures of highway construction projects to determine whether repetitions of activities amplify the impact of correlation on construction cost and time. Highway construction projects are often plagued by cost and time underestimation due to ignorance of costs and times correlation between the activities in highway projects when deterministic estimation techniques are employed. Therefore, a probabilistic model is adopted in estimating the effect of correlations on the probability distributions of total cost and total time. This study identified various types of correlations between the costs, times and cost/time in the construction of highway projects and modelled them using Gaussian copula and analyzed the impact of such correlations in the construction of a highway project using Monte Carlo simulation. The results show that the standard deviation of the total cost and total time increases with the magnitude of the correlation and type of correlation matrix and, most importantly, it increases considerably with the number of costs and times that are correlated. Based on these findings, the study concludes that the deterministic estimation technique in use does not capture the wide range of the possible total cost and time of highway projects resulting in significant overruns.

Keywords: correlation, cost and time underestimation, cost and time overruns, deterministic estimation, highway construction, repeated activity

(Paper, ID 47)

Owners' Obligations Under FIDIC Construction Contracts

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Abstract. Proper delivery of construction projects entails collaboration between contracting parties and strict performance of contracting obligations. Each contracting party has rights that need to be fulfilled by the counterparty and responsibilities that need to be performed and respected. This paper presents an analysis of the obligations of the Owner according to FIDIC construction contracts. Research on FIDIC contracts has faocused on the responsibilities of either the Engineer or the Contractor with little or no attention to the obligations of the Owner. The analysis revealed a number of obligations that include, but not limited to, the following groups: 1) pre-construction obligations; 2) obligations associated with contract documents; 3) obligations associated with the Engineer and Owner's personnel; 4) holding risks of events caused by external factors (third party actions); 5) obligations related to risks assumed by the Owner; and 6) Owner's obligations related to notification responsiblities. Proper understanding of the obligations of the Owner can contribute to minimizing disputes and claims, and as such minimizing the considerable costs associated with the resolution and settlement of these disputes and claims.

Keywords: Employer, Owner, FIDIC, Obligations, Risk Allocation.

(Paper, ID 48)

Predicting the Impact Size of Uncertainty Events on Construction Cost and Time of Highway Projects Using ANFIS Technique

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Abstract. This study examines the ability and performance of Adaptive Neuro-Fuzzy Inference System (ANFIS) as an intelligent machine learning technique in the prediction of the impact size of uncertainty events on construction cost and time of highway projects. The rationale for the study stems from widespread reports of cost and time overruns on highway construction projects and the knowledge that the cost and time of projects are affected significantly by uncertainty events. Thus, the prediction of the impact size of uncertainty events during the design phase will enable project managers in preparing a proper plan with sufficient contingencies to deal with these uncertainty events. The success or failure of prediction depends on the credibility of the prediction method. In this study, the impact size of 76 uncertain events on the construction cost and time of highway projects were predicted using ANFIS technique, and the accuracy and reliability of ANFIS prediction were assessed. The results of R-Squared and four error tests proved that ANFIS is an accurate and reliable technique for predicting the impact size of uncertainty events on the cost and time of construction projects. Based on these findings, the study concludes that the use of intelligent machine learning methods such as ANFIS will minimise the potential inconsistency of correlations in construction cost and time prediction, improved accuracy in estimated project cost and time and reduced overruns.

Keywords: Accuracy, ANFIS, Construction cost and time, Impact size, Reliability, Uncertainty events.

(Paper, ID 49)

Construction-Related Waivers to the Small Unmanned Aircraft Systems Rule in the United States

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Abstract. With the Unmanned Aerial Vehicle (UAV) industry poised to become a five-billion-dollar industry within the next year, UAVs have tremendous potential within the construction industry. From aerial surveys, jobsite photographs, and monitoring productivity and safety, UAV use could result in increased efficiency and reduced waste in the construction industry – which is notorious for having a high percentage of waste. Regulations enacted in August 2016 made the implementation of UAVs more straightforward for construction companies than had been the case in prior years. Using conventional legal research methods and a comprehensive review of Federal Aviation Administration (FAA) waivers granted since the implementation of the Small Unmanned Aircraft Systems (UAS) Rule, this paper will discuss regulations applicable to UAV use in the construction industry, the parts of the regulations for which waivers can be requested, and the number and type of waivers sought since the current regulations were enacted.

Keywords: Drone, Federal Aviation Administration, Unmanned Aerial Vehicle, Unmanned Aircraft System, Waiver.

(Paper, ID 50)

3D Scans – A New Teaching Tool in Construction Education

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Abstract. Use of technological gadgets became an integral part of Construction Management (CM) students' life. Students have different learning styles and they want their academic learning experience to be engaging and interactive. Engaging these technology savvy students in the learning process with their preferred learning style is a challenging task. The differences in teaching and learning styles result in problems such as disengagement of students and loss of learning aptitude. This active student engagement challenge can be addressed by using 3D scan model learning environment. This learning environment has the potential to make a paradigm shift in teaching and learning process. This learning environment provides a new teaching style and helps the instructor to address some of the needs of the students' learning styles. This learning environment engages students in active learning processes and helps them to focus on their learning. It also encourages students to take more responsibility for their own learning process. This paper discusses about the framework of the 3D scan model learning environment. This paper also discusses how this framework was used for development of a 3D scan model learning environment for a residential house construction process.

Keywords: 3D Scan, Learning Styles, Construction Management, Framework, Students.

(Paper, ID 51)

Impediments of the Fourth Industrial Revolution in the South African Construction Industry

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Abstract. The fourth industrial revolution (4IR) is upon us with evidence of its usage in the manufacturing industry of most developed and some developing countries around the world. Evidence of the concept of 4IR is equally evolving within the construction industry of developed countries and immense benefits are promised. However, the story is not the same for most developing countries as their construction industries face diverse challenges that impede the adoption of new concepts. Based on this notion, this study assessed the impediments of 4IR within the South African construction industry (SACI) with a view to positioning the industry in the 4IR. The study revealed the key impediments of the adoption of the 4IR concepts within the SACI. In the end, conclusions were drawn and possible directions that will help the construction industry in delivering better services to its clients using 4IR concepts were proposed.

Keywords: Construction 4.0, Digital technologies, Digitalisation, Fourth Industrial Revolution, Industry 4.0

(Paper, ID 52)

Environmental Sustainability: Impact of Construction Acitivities

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Abstract. As a result of pollution, deforestation and other environmental challenges, construction process and activities has contributed in no small measure to environmental degradation. One of the fundamental tripod of sustainability is keeping the environment safe for the inhabitants. This study, therefore, examine the impact of construction activities on the environment with a view to highlighting mitigating approaches and their enforcement strategies. A quantitative research methodology was adopted, and convenient sampling technique was employed to gather information from primary sources. Questionnaires were administered on construction professionals which include architects, quantity surveyors, engineers, safety officers as well as construction and facility managers. Construction activities impact badly on the environment due to waste generation, resource consumption, noise pollution, air pollution due to dust from construction activities as well as bad odours from large diesel-powered vehicles/construction machinery. Although, some of these impacts cannot be completely eradicated, there are a number of approaches that could be used to mitigate them, these include Environmental Impact Assessment (EIA), green building (sustainable construction), Quantitative Risk Assessment (QRA), Environmental Management System (EMS), and Environmental Protection Agency (EPA). Therefore, an effort should be made by government and

construction stakeholders to efficiently incorporate and enforce the available approaches/ initiatives through constant monitoring of construction process from start to completion and legislative laws that spell out punishment as response to violations. Awareness, learning and trainings of construction stakeholders on the impacts of building construction activities on the environment is also recommended.

Keywords: Construction activities, Construction Industry, Environment, Green building, Sustainable construction

(Paper, ID 53)

Assessment of Embodied Carbon Footprint of an Educational Building in Pakistan using Building Information Modelling (BIM)

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Abstract. The current study presents one of the few embodied carbon footprint assessments for an educational building in Pakistan. A four storey building with an area of 35,353 Sq. ft has been modeled in a 3D environment using Building Information Modeling (BIM). Life cycle assessment (LCA) methodology with "cradle to gate" boundary limitation has been adopted. A total of 922,000 Kg-CO_{2E} have been calculated with a contribution of 26.09 Kg-CO_{2E}/Sq. ft. Among the materials brick, steel, concrete, brick mortar and ceramic tile were the top contributors in the environment. Load with a collective contribution of 92.86% from these five materials. The study suggested that a proper adoption of green materials at the design stage would help to lower down these environmental concerns to promote sustainable developments.

Keywords: Greenhouse Gases(GHGs), Building Information Modeling (BIM), Life Cycle Assessment (LCA)

(Paper, ID 54)

A Strategic Approach to Emergency Preparedness in the UAE

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Abstract. Disasters have a significant negative impact across the world, and this widespread impact helps to formulate policies, reviews, measures and approaches in managing them. Global efforts towards emergency management allow organizations to join hands and provide international support to developing countries in the form of assistance from international organizations or institutions such as the United Nations (UN) or the European Union (EU) in planning, responding or recovering from identified risks or disaster. Whereas, developed countries have progressed significantly in the field of EM. Therefore, this paper puts its focus on a developed country, i.e., United Arab Emirates which has adopted its EM standards from other countries such as the UK, US, and Australia. In order to improve EM standards, the countries apply a framework for the implementation of preparedness phase which depends on eight key elements. However, the literature reveals that though UAE has emergency management standards, it lacks behind in terms of emergency preparedness framework or system. Therefore, the paper aims to investigate the state of emergency management standards in the UAE, to identify if any of the emergency preparedness elements are being practiced in any capacity, identify barriers to the preparedness phases and provide recommendations for the government to adopt the strategic approach for improving emergency preparedness in the UAE.

Keywords: Emergency Management (EM), Emergency Preparedness (EP), Management standards, Preparedness Barriers, United Arab Emirates (UAE).

(Paper, ID 55)

Embodied Carbon Footprint Assessment of a conventional Commercial Building using BIM

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Abstract. Materials are one of the major sources of carbon emissions for the construction sector. The current research aimed to assess the environmental potential contribution of a ground plus three storey commercial building in Pakistan. Life cycle assessment (LCA) along with BIM helped to develop the material inventory of conventional materials used and achieve their emissions. With a total contribution of more than 80%, steel (33.51%), concrete (19.98%), brick (14.75%), aluminum (12.10%), and paint (3.22%) were the top contributing materials. A thorough embodied carbon emission assessment at the stage of planning and design

would help to adopt proper sustainable development strategy.

Keywords: Carbon emissions, Life cycle assessment, BIM, Sustainable

(Paper, ID 56)

A Pilot of Student Guided Virtual Reality Tours

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Abstract. Construction management programs that contain technology courses, often teach students how to create building information models (BIM). The problem is that creating these models for the first few times is a difficult process. This learning process pushes students' spatial abilities to the limit as they try to understand how buildings come together while trying to perfect their final product. However, when students can view their models at a 1:1 scale instead of on a flat computer screen, they start seeing things differently. Recently, nearly 60 students took part in completing their regularly assigned BIM project in a construction technology class. With the aid of an OculusGo® virtual reality headset, students walked in their finished product and were able to critique their work from a different perspective. Furthermore, this pilot placed the student's in their model along with their classmates. This way, the author of the model could take their classmates on a virtual tour of their work, allowing multiple people to review and critique the finished product. This paper describes a pilot inquiry into the use of collaborative virtual reality in a four-year construction management classroom to improve student's building information modeling skills. This paper presents the students' feedback about the experience and documents the researcher's observations in preparation for a plenary study on collaborative virtual reality in the classroom.

Keywords: Virtual Reality, Construction Education, Active Learning, Collaborative Learning, Spatial Skills.

(Paper, ID 57)

Factors Affecting Indoor Environmental Qualities of Social-Housing Projects in South Africa

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Abstract. The South African housing delivery plan faces various economic and social challenges, which include a high unemployment rate, low income, a huge housing backlog and a lack of infrastructure, particularly in rural areas. Indoor environmental quality (IEQ) is the ability of a building to deliver adequate indoor environment beyond occupant's expectation. These expectations include the occupant's health, wellbeing, and productivity among others which are often not considered during the design stages of social-housing projects. This paper presents the results of IEQ of social-housing projects in South Africa. The study adopted a quantitative, where a questionnaire survey was constructed and distributed to occupants of social-housing in the Gauteng province of South Africa. Analysis of the primary data collected was conducted using descriptive statistics procedures. The findings revealed that the major factors affecting IEQ of social housing occupants were indoor air quality parameters, level of privacy, acoustics sound between the units and level of visual comfort among other factors. Also, the occupants were not satisfied with the overall state of their IEQ which was driven by the above factors. Thus, creating a provision for IEQ aspects during the design and administration phases of social-housing projects will make social-housing more desirable in South Africa.

Keywords: Air quality, Occupant Satisfaction, Thermal comfort, Social housing.

(Paper, ID 59)

Construction Health and Safety (H&S) Practitioners' Developmental Needs

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Abstract. A South African industry H&S status report reported a deficiency in terms of effective management and supervision of H&S on construction sites, and referred to the lack of sufficiently skilled, experienced, and knowledgeable persons to manage H&S on construction sites. The study reported on constitutes a further phase in terms of assessment of the status quo of construction H&S practitioners' performance and developmental needs. A self-administered survey was conducted among members of the Association of Construction Health and Safety Management (ACHASM), and ACHASM continuing professional development (CPD) events' delegates. The salient findings include: respondents' source of H&S knowledge is predominantly informal, and CPD would contribute to an improvement in respondents' knowledge and skills relative to nine SACPCMP knowledge areas, five SACPCMP scope of services' areas, eight composite knowledge areas, and seven composite skills areas.

Conclusions include: there is potential for construction H&S practitioners to enhance their knowledge and skills; CPD is necessary and should be provided relative to all the knowledge and skills areas, and undergraduate and honours level construction H&S qualifications are necessary to remedy the situation.

Keywords: Construction, Development, Health and Safety, Practitioners.

(Paper, ID 60)

Construction Contingency Determination: A Review of Processes and Techniques

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Abstract. Contingency provision on a construction project is one of the risk management techniques embraced by project owners to deal with project unanticipated expense (spending) and time overruns. However, contingencies could be overestimated or underestimated. The current study therefore investigated how contingency is determined on construction projects and the benefits of contingency planning. A literature review of literature was undertaken from various databases including Academic Search Complete, Google, Goole Scholar, Ebscohost and others. The materials used were selected based on their possession of the key words related to the study. Thematic content analysis was used to identify themes on cost and time contingency planning process and techniques. The findings revealed that the process of cost contingency determination entails identifying different scenarios of events and risks, and developing the plans based on the potential responses to the identified risks. Further findings revealed that various techniques may be used in the process and practice of estimating cost and time contingencies. The findings are envisaged to be beneficial to construction stakeholders assess and improve on contingency planning process on projects.

Keywords: Construction, Contingency, Planning, Project management

(Paper, ID 61)

Practical Application of Natural Pozzolans and Lime for Cost Optimisation in Low Cost Housing

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Abstract. Portland cement is considered one of the costly construction materials. It is sometimes used in applications where its strength levels are not necessary. This study optimized the use of OPC by considering its substitution with pozzolanic materials to reduce construction cost. The pozzolnic material used was volcanic ash which is abundant in many parts of Uganda. The ash was mixed with lime and water. The study examined the pozzolan-lime system to determine its optimum performance for a given pozzolan with known mineral composition. The work was experimental involving testing trial mortar cubes of different pozzolan-lime blends and varying pozzolan particle sizes. The results yielded second order polynomial relationships between the achieved compressive strength and the pozzolan-lime content. The optimum blend was determined from the first derivative of the functions. The blends that would yield the highest possible compressive strength values were derived from the absolute critical points of the polynomials, which when substituted into the functions yielded the actual peak values. Using the best fitting polynomial models, the maximum possible compressive strength values were generated. The blends containing pozzolans of 125microns particle size yielded consistently high peak values for all the experiments. The optimum blend was determined using the 125micron function, and the pozzolan-lime content that yielded consistent results was between 54% and 60%. The achieved compressive strength was 0.9MPa, which is expected to increase for pozzolans with finer particles. The values attained are adequate for a number of low-strength construction applications. The use of OPC can be restricted to only structurally-sensitive elements like beams and columns. This would serve to reduce the demand for OPC in housing construction and also reduce the cost of construction.

Keywords: Pozzolans, Volcanic Ash, Low-Strength Construction Applications

(Paper, ID 62)

External Components of Premature Construction Project Closure

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Abstract.
Construction projects failures are often attributed to the slackness of different project stakeholders. However, it is important to note that the success or failure of construction projects can span from characteristics that could either be internal or external to the project. Thus, this study explores the elements external to a construction project that can lead to premature closure. Data for the study was gathered through a survey of construction professionals within the Gauteng Province of South Africa. The questionnaire survey was designed to collect data pertinent to achieving the aim of the study. The data gathered was analysed using descriptive analysis to rank the measured factors. The results revealed that environmental, social and political considerations are the important elements that lead to the failure of construction projects and lead to premature closure. It was therefore concluded that before project take-off, various environmental forecast and analysis should be conducted to reduce the probability of project flow interruption, thus reducing the risk of closing projects prematurely.

Keywords: Project external factors; Project failure; Project success; Construction projects; Premature project closure.

(Paper, ID 64)

Exploring Critical Success Factors for Geothermal Investments

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Abstract. The number of geothermal energy investments has been increasing every year to satisfy the growing demand for energy. Determining the success factors in geothermal energy investments is crucial to ensure project success. This research aims to identify the critical success factors and their effectiveness rate for geothermal energy investments in Turkey. To achieve this objective, an extensive literature review was performed to determine the critical success factors associated with geothermal energy investments, and a questionnaire survey was conducted to assess the effect of each success factor. The results show that the three most important success factors are "feasibility of the project", "energy demand" and "tariff rate". These findings can help the investors to successfully implement a geothermal investment.

Keywords: Public-Private Partnership (PPP), geothermal, renewable energy, critical success factor (CSF), project

(Paper, ID 65)

Mitigating Skills Shortage in the South African Construction Industry

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Abstract. Constriction industry is multifaceted and multidisciplinary with the presence of diverse stakeholders including the skilled and unskilled workforce. Over the years, there has been a decrease in the number of skilled workforces in the South African industry due to such factors as emigration, poor education system, etc. This study examines different remedies to the skills shortage in the construction industry with a view to maintaining excellence and enhancing the performance of construction projects. Using closed-ended questionnaires as the research instruments, necessary factors from the literature were compiled and examined by distributing the questionnaires to the skilled workforces in the construction industry, which are professionals and artisans. Analysis of the collected data revealed that the major remedy to skills shortage in the industry is through the organization of training courses for a non-English speaking citizen from various regions of the country. There is also a need for training of the skilled workmen in the area of business skills, management skills, and job instruction. This study will be useful for construction education training agency (CETA), construction professional bodies, trade unions and other agencies that are tasked with the responsibilities of promoting, regulating and training of the skilled workforce in the construction industry in discharging their roles effectively and efficiently.

Keywords: Education, Incentive, Mentoring, Skill development, Training.

(Paper, ID 66)

Effect of Insulation Thickness on Energy Consumption for Different Shaped Buildings

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Abstract. Control and management of energy consumption are becoming more and more important due to the rapid depletion of fossil energy resources and the increased environmental problems caused by them. A large amount of energy is consumed in the buildings. Therefore, priority is given to applications that reduce the amount of energy consumed during the utilization phase of buildings. Decisions regarding building shape and insulation thickness have a considerable effect on building energy costs. Therefore, this study will analyze the effect of insulation thickness on the energy consumption of residential buildings that have different shapes. The building shape is evaluated with an external envelope area to the building's gross volume (A/V) ratio and external wall area/floor area (EWA/FA) ratio. 4 building shapes with different external wall area are selected for this study. The maximum and minimum energy costs of each building shapes are calculated based on 14 different envelopes and 8 different orientation alternatives taking into consideration the solar gain. The effects of insulation thicknesses on energy costs for different shaped buildings are determined by comparing energy costs. It will provide pre-design information for future reference for residential buildings with less energy consumption and less environmental pollution.

Keywords: Energy cost, insulation thickness, building shape, energy consumption, building envelope.

(Paper, ID 68)

Construction Site Fire Safety Using BIM and Virtual Reality

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Abstract. Due to the dynamic nature of a construction job site, it is challenging to ensure safe operations and avoid accidents. It is imperative to provide/facilitate effective safety workshop/training programs, especially for new employees to familiarize them with the existing hazardous situations on site and ways to address them. Although various visualization techniques were investigated in the past in other industries, their implementation in the construction industry with an emphasis in site safety is still in its infancy. This paper provides the use of Building Information Modeling (BIM) and Virtual Reality (VR) in improving the current scenario of safety in the construction industry, with a particular emphasis on fire safety. This work deals with a combined approach of BIM and VR technologies. These technologies are linked together to develop an immersive environment that provides access to critical locations in case of an emergency such as, the location of fire extinguishers, and exit route for emergency evacuation. This paper investigates the potential of site safety and emergency response management in the construction industry.

Keywords: Construction Safety, Building Information Modeling, Virtual Reality, Fire Safety.

(Paper, ID 69)

Forecasting Rental Values of Residential Properties: A Neural Network Model Approach

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Abstract. The current study intends to use the neural network (NN) algorithm for modelling and forecasting of rental values of residential properties located in Cape Town, South Africa. Data relating to property attributes and its rental value were collected. Neural network algorithm was applied in this study. The collected data was divided into two parts. The first part was used for the development of the model. Subsequently, the developed model was used to generate the forecast of rental values of residential properties. For the second part of the data, the accuracy of the model was evaluated by comparing the predicted class and actual class. Experimental results gave an accuracy of 66.67% for the test dataset. It was also found that floor area has the most significant impact on the rental value of residential properties within the study area. This study demonstrates that the neural network algorithm could be applied to real-world investigations focused on prediction of rental values of residential properties.

Keywords: Classification, Forecasting, Modelling, Property Economics, Rental Value

(Paper, ID 70)

Costing of Health and Safety elements in Construction Projects in Gauteng, South Africa

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Abstract. The current study reports on findings from a study on the costing of health and safety elements in construction

projects. Nine construction projects were purposively enrolled to the study, comprising six civil engineering and three building construction project. The findings showed that H&S elements were costed by contractors using an itemised breakdown even though such items were not included as a trade items in the Bills of Quantities (BOQs). The costs established from actual expenses incurred on construction projects revealed that H&S expenditure ranged between 3% and 4% for projects with a value below R500 million and between 4% and 5% for projects with a value above R500 million. Further, H&S costs were found to be directly proportional to the projects value and indirectly influenced by the client. Costing of H&S elements has been a challenging task as there is no standard on how H&S elements should be priced in the South African construction industry. The lack of a framework to assist with costing of H&S elements on construction projects makes accurate and adequate monitoring of H&S costs to be problematic. Thus, a standardised pricing framework can assist contractors to cost and for clients to adequately evaluate bids and or variations on construction projects, and to ensure that provision for H&S as provided for by the Construction Regulations 2014 is made.

Keywords: Construction, Costing, Health and Safety (H&S), South Africa.

(Paper, ID 71)

An Assessment of Factors influencing Collaboration and Impacts on Organisational Performance: A Review

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Abstract. Poor organisational performance is partly attributed to lack of collaboration within an organisation. Therefore, this paper sought to establish the factors that influence collaboration and the impact of collaboration on organisational performance. A literature review was conducted to achieve the objectives of the study. Literature from Google Scholar, Emerald, and Science Direct were used, based on the keywords relevant to the study. The materials consulted included journals and conference proceedings. Thematic content analysis was used to identify factors that influence collaboration in an organisation. The findings revealed that collaborative leadership, collaborative culture, attributes of partners, strategic and external environment factors influence collaboration. Further findings revealed that collaboration could influence an organisation's performance in terms of knowledge creation an transfer, innovativeness, ability to leverage resources to achieve maximum benefits, as well as competitive advantage. This study provides knowledge on which factors influence collaboration in order improve the quality or extent of collaboration in an organisation. By understanding the factors of collaboration, which in turn influence organisational performance, strategies can be developed to encourage collaboration and thus performance, by the stakeholders and managers.

Keywords: Collaboration, Organisations, Performance, Success

(Paper, ID 72)

A Hybrid Conceptual Model for BIM Adoption in Facilities Management: A Descriptive Analysis for the Collected Data

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Abstract. Despite the approved benefits of Building Information Modelling (BIM) for the whole project life cycle, the adoption of BIM in facilities management(FM) is only minimal. Still, BIM adoption and implementation in FM is unclear. Thus, this ongoing research aims at identifying the main factors that affect the acceptance of BIM in facility management. Also, it aims to framework a hybrid conceptual model that integrating Task Technology Fit (TTF) and Unified Theory of Acceptance and Use of Technology (UTAUT) for better understanding the use of BIM in FM. The methods that are being adopted in this research include a comprehensive literature review, interviews and survey. The proposed conceptual model for BIM in FM was already developed in the previous paper. In this paper, a summary of interim findings and an overview of the online survey and data collection procedure are presented. Also, a descriptive analysis for the sample size of 134 responses are discussed. The general results showed an interesting findings and acceptable level of participants'

qualifications to answer the online survey. The future work will include the model constructs' validation and test of the research hypotheses.

Keywords: Facilities Management, Building Information Modelling (BIM), Unified Theory of Acceptance and Use of Technology (UTAUT), Technology Task Fit Model (TTF)

(Paper, ID 73)

A Model Validation and Predicting the Rental Values of Residential Properties Using Logistic Regression Model

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Abstract. The property market is a key contributor to the economic growth of many countries. This makes information from property valuation reports vital for decisions on real estate investments and property tax. Unfortunately, literature reveals that inaccurate property valuation arising from a reliance on traditional methods of valuation remains a major problem facing real estate practice. To improve the prediction accuracy of property valuation estimates, modelling techniques such as neural networks have previously been applied to this problem. This present study uses a logistic regression model to predict the rental values of residential properties in Cape Town, South Africa. Field survey data was divided into two groups: training and test sets. The training set was used for model development while the test set was used for model validation. The results of the study revealed that parking, garden, number of bedrooms and floor area have the most significant impact on the rental values of residential properties. Surprisingly, proximity to a police station has one of the least effects on the rental values of residential properties. With a prediction performance of over 70% accuracy, findings indicate that the logistic regression model is suitable for predicting the rental values of residential properties. This study evaluates the factors that influence the rental values of residential properties located within the study area. The developed model can serve as a decision support tool for estimating the tax payable by property owners.

Keywords: Residential Property, Rental value, Logistic regression modelling, Prediction, Tax

(Paper, ID 74)

Blockchain in Construction Practice

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Abstract. The construction industry is one of the most important sectors of most economies. However, the sector has been plagued with many challenges, including low productivity, lack of collaboration, inadequate/insecure information sharing and lack of trust between participants. To overcome some of these challenges, blockchain, one of the emerging technologies has been hailed as a solution for sharing and distributing information securely. While blockchain has been widely popularised in the financial fields through well-established cryptocurrencies such as Bitcoins and Ethereum, the same cannot be said of the construction industry. The application of blockchain in the construction sector is yet to be widely documented in academic literature. This study explores the application of blockchain technologies in the construction sector. Specifically, the operational principles, applications, associated benefits, and weaknesses of blockchain in construction practice are examined in this paper. The paper concludes that there is definitely a huge potential in the adoption of blockchain in different construction processes.

Keywords: Blockchain, Distrubuted Ledger Technology, Built Environment, Construction, Innovation.

(Paper, ID 75)

Emerging BIM-3D-Laser Scanning Integration in Construction Practice

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Abstract. The up scaling of innovative information and communication technologies to feasible application within the construction industry is receiving increasing attention, research and funding from public and private agencies. Emerging Building Information Modelling (BIM) and 3D-laser scanners are amongst the leading technologies being recommended for use in construction. Although the potential of BIM in the capture and exchange of construction information has gained interests amongst researchers, the same cannot be said of the 3D-laser scanners. By appropriately integrating data from 3D-laser scanners with BIM can lead to greater benefits in managing construction information. However, the nascent nature of BIM and especially 3D-laser scanners means the nexus of these

technologies is yet to be fully understood. This study investigates the use of 3D- laser scanners together with BIM in the optimisation of information exchange across the lifecycle of a construction project. The specific questions to be answered are what are: the practical applications of 3D-laser scanners? How can 3D-laser scanning be integrated with BIM to maximise information gathering and processing for the different applications? What are the benefits and challenges of adopting integrated 3D-laser scanners and BIM in practice? After addressing these research questions, this paper concluded by a way of summary and further discussed the direction of future research.

Keywords: Building information modelling (BIM), 3D laser scanning, Point clouds, 3D modelling, Automation.

(Paper, ID 76)

Modelling Hospital Functional Performance Under Surge Conditions—The Application of FRAM and RAM

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Abstract. Nonlinear models for understanding complex socio-technical processes have not been fully adopted in the examination of hospitals' functional performance when managing the effects of disruptive events. In the literature, researchers have focused on the various dimensions of hospital functional performance (HFP) using different methods. However, they have not sufficiently addressed the inherent behaviours of systems that diminish the efficiency and effectiveness of HFP when operating under different protocols. The current paper aims to identify the pathway through which functional variabilities may propagate throughout the system when dealing with medical surge. To achieve this objective, the application of the functional resonance analysis method (FRAM) is integrated with the application of the resilience analysis matrix (RAM) to analyse HFP. The results identify 23 couplings in 153 interactions between 29 functions that have the potential to affect overall HFP. The approach of this research has revealed how managing the variability of certain interactions can enhance the efficiency and effectiveness of HFP in dealing with disruptive events.

Keywords: hospital functional performance, resilience, functional resonance analysis method.

(Paper, ID 77)

Water Content Effect on California Bearing Ratio of Cohesive Soil

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Abstract. The CBR test is a simple and well recognized method of assessing the strength of subgrade. There are also many other Geotechnical tests which can be used to ascertain the quality of the subgrade soil, the quality of the soil that is used for subgrade may differ and this may depend on the amount of water that seeps through the soil. In this study, the degree of soaking was varied in days starting from un-soaked (0 day) to soaked (day 1) up to (day 5) to enable the measurement of the saturation level in different types of soil in Awgu LGA. Furthermore, the Engineering features of the soils which included the CBR at different saturation levels were also studied. According to the results obtained, as the soaking period increases from day 1 to 5 for all the samples, there was remarkable decrease in the CBR of soil samples from 100% to 5% in all the samples.

Keywords: Moisture Content, California Bearing Ratio, Cohesive Soil.

(Paper, ID 78)

Investigation of infrastructural Maintenance in Public Institutions in Nigeria

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Abstract. Maintenance is the act of protecting an infrastructure from decay or dilapidation so that it will continue to remain new, retain its economic importance and durability which will make the infrastructure more sustainable. When an infrastructure is sustainable it benefits and serves the present generation without denying the future generation its own benefits. This study was conducted between 2016 and 2018 to investigate the level of infrastructural maintenance in public institutions in Nigeria using the University of Nigeria, Nsukka campus as a case study. From the field investigation conducted during this

study, it was observed that the University rely more on corrective maintenance which involves conducting maintenance when the infrastructure is already damaged rather than implementing preventive maintenance which involves conducting maintenance to prevent unseen damages which may occur. It was also observed from the field investigation that one of the major problems of maintenance in government owned institutions is lack funding for infrastructural maintenance. In this study it was observed that offices and classrooms in the 10 faculties housed by the University of Nigeria, Nsukka campus needed over 40% maintenance work on their walls, floor, roof, paint, window, toilet, electrical installations and doors. The faculty of Pharmaceutical science had the most maintenance problem in both the offices and classrooms. It was recommended that a holistic maintenance model should be followed in line with international best practices in advanced countries. The University should develop and follow a preventive maintenance policy by employing the services of a good maintenance/management firm to maintain and manage the University infrastructures while the works services department serves a supervisory body. In line with the trending 4th industrial revolution, it is recommended that the University should introduce the use of one stop shop maintenance services using information and communication technology (ICT). Special soft wares should be developed which can be used to keep records of building projects starting from the design, As built, till the end of the project, this can help to identify maintenance problems easily.

Keywords: Maintenance, Infrastructure, Institutions, Public, Investigation

(Paper, ID 79)

How Can Mobile App Technology Further Benefit Project Managers by Improving & Increasing Working Productivity?

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Abstract. Innovative technology has been exploding and prevailing among various industries during the 21st century all over the world. Not only through its use and adoption of innovative technology which provides convenience and efficiency across various sectors, but by using technology to improve quality of life and influencing and shaping human behavior. Whilst some industries like business marketing and social media sectors have been quick to embrace these innovative technologies, it could be argued that the built environment sector has been hesitant and slow to embrace such innovative technologies. Innovation, as defined by the Chartered Institute of Building (CIOB) 2007, as *a "successful introduction of new technologies or procedures into the industry, although not always profit driven; it can enhance sustainability, energy saving and reduction in carbon emission."* With innovation and sustainability key drivers for the built environment sector this investigative research will review why technologies like Augmented Reality (AR), Virtual Reality (VR), Building Information Modelling (BIM), Modular Integrated Construction (MiC), Radio Frequency Identification (RFID) and Smart Mobility have been in-part resisted by the Hong Kong built environment sector and what impact this lack of engagement may have on productivity on construction /project management. In particular how adoption might increase working productivity in project administration throughout the entire construction period. This research included an investigation into the current position relating to utilization of mobile app technology in Hong Kong, appraised the performance of construction sector mobile app technology to increase productivity of project managers and compared productivity values by using "Productivity Equation" before and after the adoption of construction mobile app technology.

Keywords: Mobile app technology; Increased productivity; Project management; Adoption of mobile app technology.

(Paper, ID 80)

Temporary Homes in Disaster Hit Areas

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Abstract. Temporary housing plays a critical role in post disaster recovery efforts but due to their unsustainability, cultural inadequacies, and being expensive they are not seen as a suitable resolution. Thus, due to the need of an integrated and more responsive strategy has becomes evident to better utilize the recovery and relief resources. The aim of this research is to explore use of the temporary housing in the post-disaster situations by addressing both physical and psycho-social safety/health issues and potential solutions to improve implementation of temporary housing. Furthermore, this research determines the, re-use and recycle, potential of temporary housing units after occupancy in post-recovery areas. This research also tries to identify how deconstruction is utilized and the benefits in post-disaster situations and determine the role and

effectiveness of community participation during the post-disaster recovery situations. In the first part, this paper introduces the topic, then delivers the state of the art literature survey. Paper also justifies the chosen methodology followed by discussion and conclusion.

Keywords: Temporary Homes, post disaster situation, Issues and criticism of temporary housing

(Paper, ID 81)

Characteristics of Bidding for Engineering Services in Public Construction Projects

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Abstract. Engineering services to construction projects are essential to the proper delivery of construction projects. Engineering services includes both design services before construction and engineering supervision during the construction phase of the projects. Procurement of engineering services for public construction projects are performed through competitive bidding. Several scholars investigated the bidding characteristics of contractors while few or no research has addressed the bidding characteristics for engineering services. This paper presents an analysis of bidding results of 450 invitations to bid for engineering services. The analysis revealed considerable differences in bidding between design bids and construction monitoring bids. Also considerable differences in bidding characteristics exist between construction sectors that include: buildings, transportation, water and sanitary projects, and infrastructure projects. The performed analysis and the results obtained is expected to contribute to better understanding of bidding behavior of engineering consultants for engineering services and the suitability of the competitive procurement approach to this kind of projects. Construction planners can evaluate these characteristics and consider other procurement approaches for projects that involved wide disparity in the received bids in competitive bidding. Selecting proper procurement approach is expected to contribute to enhanced delivery of construction projects.

Keywords: Competitive bidding, Engineering Design, Construction Monitoring, Engineering Supervision, Engineering Supervision.

(Paper, ID 82)

Estimating the Productivity of the Bosnian-Herzegovinian Water Operators

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Abstract. This paper deals with the issue of productivity of municipal water operators in Bosnia-Herzegovina (BIH). It demonstrates that Stochastic Frontier Analysis (SFA) could be a useful tool in assessing productivity and the relative efficiencies of water operators.
The principal aim of this paper is to show that it is worth assessing the productivity improvements that could result from better use of inputs, primarily labor. In spite of severe scarcity of data for the BIH water sector, collected data allowed us to develop a SFA model with a set of inputs (number of connections, number of workers, electrical energy costs and chemical costs) and outputs (water delivered) as required in the water sector empirical literature.
The research could serve as a benchmark against which future quantitative analysis of water operators' productivity can be measured. It could additionally provide policy-makers with comparable quantitative evidence on the functioning of water operators with the aim of regulating them more effectively and improving the performances of one of the most poorly functioning water sectors in Europe.

Keywords: Water Operators, Productivity, Stochastic Frontier Analysis (SFA).

(Paper, ID 83)

Quality Assessment of Sandcrete Blocks Produced with River Sand in Ogun State, Nigeria

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Abstract. In Nigeria construction industry sandcrete block is an important building material, it is used in the construction of the building and other useful physical infrastructure. Many of the sandcrete blocks are produced at different location and environment using different aggregate materials without resort to the minimum quality standard

expected of the sandcrete block. It is on this bases that the study assessed the quality of sandcrete block produced with river sand in order to determine their compliance level to the standard expected of a sandcrete block. Eighteen (18) numbers of sandcrete blocks of size 225mmx225mmx450mm were gotten from three different production locations in Ifo, Ogun state Nigeria. Sieve analyses, bulk density, silt content, and the compressive test was carried out to determine the property quality of aggregate material (river sand) used for the production of the blocks and its strength. The result shows that the aggregate material used was of good quality suitable for the production of the sandcrete block. The result also shows that the average compressive strength of 1.16N/mm2 for sandcrete blocks from different production sites does not meet up with the minimum requirement for sandcrete block compressive strength as stipulated by NIS 2007 and ISO 848492-1994. The study revealed that the quality of the block produced is not affected by the quality of aggregate used but by poor quality control of aggregate and other materials used in the production of the blocks. It further revealed that the block quality is also affected by shoddy/improper curing of blocks produced. The study, therefore, concluded that regulatory and professional bodies should organize seminars for the local producers of sandcrete blocks on the best practice of producing quality blocks in meeting the required quality standard for construction work to avoid structural cracks and collapsing of building.

Keywords: Sandcrete block; Sieve analysis; Bulk density; Silt content; Compressive strength.

(Paper, ID 84)

Experimental Investigation of Concrete Block Walls Compressive Strength Using a Non-Destructive Test

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Abstract. The non-destructive test is an inexpensive measure of surface hardness that is used to determine the theoretical relationship between the strength of hardened concrete block walls and the rebound number of the hammer. This study analyzed the compressive strength of concrete block walls a building using a non-destructive test. Data was collected using the impact method (Schmidt rebound hammer) on three sides of the building concrete block walls. The standard experimental procedure for impact method was followed and the analysis of the result was presented through tables and figure. The result shows that the Rebound value (R) of the three sides for the concrete block walls (R) were 17.21N/mm^2 (CBW1), 15.01 N/mm^2 (CBW2) and 16.1N/mm^2 (CBW3). The average compressive strength for all the CBW tested in relation to the rebound value (R) is 16.1N/mm2, which shows that the compressive strength of the concrete block walls is within the stipulated minimum compressive strength of 12.5 N/mm^2 for load-bearing concrete block work, using Ordinary Portland Cement and suitably graded fine and coarse aggregate in accordance to BSEN1971-1 2011. The study indicated that a non-destructive test using Schmidt rebound hammer is suitable for testing of building structures because it does not compromise the performance of component or structure being investigated and it's quality. The study concluded that the structure tested using the non-destructive test is safe and suitable for habitation

Keywords: Non-Destructive; Concrete Block Wall; Rebound Value; Compressive Strength.

(Paper, ID 86)

Reviewing Problem-Solving as a Key Employability Skill for Built Environment Graduates

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Abstract. The benefits of possessing problem-solving skills cannot be over-emphasised. From fresh graduates to industry employees, this skill is pivotal in achieving one's goals as well as functioning effectively in the construction industry. Several researchers have suggested that industry employers value graduates who possess practical problem-solving competencies and can deliver timely and implementable solutions to arising industry problems. Hence, this paper focuses on the benefits of possessing problem-solving abilities and possible ways to foster them in higher education. This study was conducted via a review of relevant literature from peer-reviewed journals and conference articles from databases including EBSCO Host, ProQuest, SciVal, Springer, Taylor and Francis online, Emerald, amongst others. Notable findings from this study revealed that brainstorming, Root Cause Analysis, Cause and Effect Diagram, Pareto chart, Flowcharting and decision matrix are among some of the ways by which problem-solving skills are developed in higher education institutions (HEIs). The study also found that problem-

solving skills could be developed among students by moving from teacher-centred approaches to student-centred approaches. These range from case-based teaching, discovery learning, problem-based and project-based learning amongst others. It is recommended that present-day HEIs engage built-environment students even more by integrating project-based activities into their curricula, to holistically prepare the next generation of industry professionals.

Keywords: Problem-Solving Skills, Higher Education, Student-Centered Approaches, Construction Industry, Employability.

(Paper, ID 87)

A Socio-Cultural Perspective to BIM Adoption: A Case Study in South Africa

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Abstract. The implementation of BIM in construction organisations requires various strategic and change management processes. The effect of organisational culture, manifested through external survival issues, internal integration issues and underlying assumptions, on BIM adoption are absent in the literature. This paper aims to illustrate that a focus on these three level of cultural manifestation within AEC organisations could lead to improved analysis of BIM adoption. An architectural organisation based in South Africa is used as a case study. Mixed method of data collection was adopted to analyse BIM's manifestation in an Architectural organisation's culture. Interviews were conducted with key members in the organisation, and survey data of 29 respondents was used to triangulate and develop consensus about the underlaying assumptions relating to BIM. The results showed how each of the three levels of cultural manifestation is influencing BIM adoption. In particular, the findings revealed that leaders' perceptions greatly impact the adoption of BIM through the three levels of the organisational culture.

Keywords: Building Information modeling, BIM, BIM diffusion, cultural values, behaviour, organisational culture.

(Paper, ID 89)

Digital Asset Information Management for Transport Infrastructure: Framework and Implementation

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Abstract. Asset management is the systematic process of deploying, operating, maintaining, upgrading and disposing of built environment assets. Effective asset management requires the involvement of all levels of an organisation in planning, control and monitoring of asset performance that combines management, financial, economic and other activities and practices. This paper aims to propose and evaluate a framework for digital asset information management, including four four elements – data exchange, classification system, location referencing and information requirement. This framework is validated through interviews with a road agency in Australia. It is expected that this framework is useful for road agencies to evaluate their current practices and take appropriate actions towards digital asset information management.

Keywords: Digital engineering, asset management, information management, location referencing.

(Paper, ID 91)

Challenges Affecting Leadership Development in the Construction Industry

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Abstract. The study adopts a data reduction method to examine the presence of any complex configuration among a set of variables on challenges affecting leadership development. A structured survey questionnaire was administered to 111 project managers and construction managers to extract the relevant data, and this produced a relatively high reply rate. After satisfying all the necessary tests of the reliability of the survey instrument, sample size suitability and population matrix, the data was subjected to principal component analysis, resulting in the classification

of three new thematic leadership development challenges areas; and were explained in terms of leadership education and training; leadership succession challenge; political instability. These knowledge areas now form the basis for oblique leadership development training requirements in the context of the South African construction industry. The main contribution of the paper is manifested in the use of the principal component analysis, which has rigorously presented an understanding of the complex structure and the relationship between the various knowledge areas. The originality and value of the paper are embedded in the use of contextual-task and conceptual knowledge to expound the three uncorrelated empirical utility of leadership development challenges.

Keywords: Challenges, Factor Analysis, Project Manager, Leadership Development

(Paper, ID 92)

Critical Success Factors for Improved Organizational Performance

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Abstract. The need for optimum organizational performance necessitated the assessment of the possible impact of human resource management (HRM) on both management and organizational performance of construction organizations. The study adopted a quantitative survey approach wherein information was solicited from HRM Personnel, Senior Management, Departmental Managers, and Union Representatives within a Grade 9 construction organization in South Africa using structured questionnaire as the research instrument. Data gathered were analyzed using mean item score, standard deviation and Pearson moment correlation. The reliability of the research instrument was tested using Cronbach alpha test, while the normality of the data gathered were tested using Shapiro-Wilk test. The findings of the study revealed that managers are key in ensuring that employees are motivated and well trained. Also, communication between both parties should be clear with no ambiguity. Additionally, compensation and benefits, promotional opportunities and performance and appraisal systems should be fair. Moreover, employees' performance and commitment to a firm is influenced by their level of motivation. It is believed that the findings of this study, when applied within construction organizations in South Africa, will assist management in improving their HRM activities in order to achieve better organizational performance.

Keywords: Human Resource Management Practices, Employee Performance.

(Paper, ID 93)

Enhancing the Visualization of Problems Tracking and Management Integrated BIM Technology for General Contractor in Construction

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Abstract. Recently, BIM (Building Information Modeling) technologies are utilized for general contractors in various applications of construction managements. The applications of BIM technologies become the most critical and useful tool for construction management during the construction phase. Despite many articles and much discussion in practice and academic literature, there is a lack of systematic approaches to enhance identified BIM-based problems illustration and tracking management for effective construction management. With the utilization of the API (Application Programming Interface) and web-based system development for BIM-based problems illustration and tracking management, this research proposes a new and practical methodology to apply BIM-based problems tracking and management. Using API and web-based system development, this study proposes a BIM-based tracking and management of identified problems for general contractors. Furthermore, the proposed system can enhance the effective of BIM-based tracking and management of identified problems integrated BIM technologies. The proposed system is then applied in selected case study of a building project in Taiwan to verify our proposed methodology and demonstrate the effectiveness in practice. Finally, this study summarizes the advantages, limitations, and suggestions for further BIM-based tracking and management of problems in construction management.

Keywords: Building Information Modeling, BIM, construction management, general contractor, system development.

(Paper, ID 94)

Challenges of Conducting Market Research During Project Appraisals of Real Estate Investment

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Abstract. Real estate investments are known for requiring huge capital outlay thereby making prospective investors interested in understanding the risk and possible return from their investment. The risk and return attributed to the investments can only be revealed through conducting project appraisals. Unfortunately, the project appraisals of real estate investment are tainted with numerous inaccuracies and discrepancies. These inaccuracies have been attributed to poor market research conducted by Estate Surveyors and valuers. Therefore, this study appraises the challenges of conducting market research during project appraisal of real estate investment. The study adopted convenience sampling for administering the questionnaire to Estate Surveyors and Valuers in Lagos metropolis. A total of 56 questionnaires were obtained from the professionals out of 70 that were distributed. The data were analysed with statistical package for social science (SPSS version 20), using, mean score and Kruskal Wallis test. The study discovered that the challenges faced by the Estate Surveyor in conducting market research are pressure from their clients to deliver the appraisal report and difficulty in sourcing information. The study recommends that a data bank should be created to facilitate the ease of information sourcing. The study contributes towards improving the quality of project appraisal in the country.

Keywords: Estate surveyor**,** Market research, Project appraisals**,** Property investor.

(Paper, ID 95)

Road Infrastructure Project Success: Understanding the Role of Stakeholder Management in a Rural Setting

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Abstract. This paper analyzed the effects of stakeholder management(SM) on rural road construction projects using as a case study. Increasing road construction projects failure and abandonment and the impact on the citizens' wellbeing in two administrative areas were the motivation behind this research. Several authorities support the position of a relationship between stakeholder identification and management and rate of success of road construction projects. The main research instruments used was a standardized questionnaire based on Likert five-point scale. The data collected from the respondents in the field were subjected to Analysis of Variance (ANOVA) F- Test. The result showed that, there is a significant relationship between failure and abandonment of road construction projects and the management of stakeholders. Proper project stakeholder identification has a significant contribution to the implementation of successful rural road construction projects.

Keywords: Construction, Imo, Insurgency, Stakeholders, Road..

(Paper, ID 96)

Current Sources of Financing Power Infrastructure in Developing Countries: Principal Component Analysis Approach

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Abstract. Infrastructure plays the dominant role in structuring and positioning every nation's economy and social development. Infrastructure financing is the blue print in achieving infrastructure development in developing and developed countries. This research project determines the current sources of financing infrastructure in developing countries. The study adopted a quantitative research approach with data gathered from the respondents within power infrastructure development in the region. The findings revealed current sources of financing power infrastructure in developing countries to be commercial bank loans, public finance, private finance, power utility fees, public-private partnership, foreign direct investment. These were seen as current sources of financing power infrastructure in developing countries. Having established that no society can

develop without adequate investment in the power infrastructure sector, there is a call for adequate investment in the power infrastructure to foster and re-integrate developing countries in the path of economic development and global relevance. If the central government can direct adequate finance and harness the current sources available to develop power infrastructure in their society, it will ultimately lead to enormous economic growth and social development in the region. This research project will contribute to the development of public infrastructure in developing countries, which will directly influence the development of power infrastructure in the region for the purpose of economic relevance and improvement of lives in the society.

Keywords: Economic growth, Developing countries, Power infrastructure financing, Power infrastructure development, Social development

(Paper, ID 97)

Automation in Museum Construction and Operation

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Abstract. The conventional method in construction has many limitations and therefore needs modification. Not only is this method inefficient, but it is also harmful to the environment due to its high energy consumption. Therefore, there is a rising need for automation in construction. This need is accentuated in specific structures, such as museums, that are more creatively designed and have more specific maintenance and operation requirements. The purpose of this paper is to create a tool kit for automating the design, construction, and operation of museums while considering sustainability measures. The main methodology is research on the application of Building Information Modeling (BIM), robotics, and 3D printing during the design and construction stages, and examination of the integration of the Internet of Things (IOT) and indoor air quality management into the operation stage. The results are workable guidelines for the automated museum. The tool kit is beneficial as it will save time and cost and increase the efficiency of operation. It will also increase awareness of the necessity of new job opportunities for labor within the technology sector.

Keywords: Automation, Sustainable Construction, Museum Construction, 3D Printing, Robotics, Internet of Things, Indoor Air Quality.

(Paper, ID 98)

Perception of University Students on Gender Issues in the Industry

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Abstract. The UK construction industry is currently suffering from a skills shortage. There are many reasons and issues that surround this, however Office of National Statistics data shows only 13% of the construction industry is employed by females. This research study will discuss the perception of the construction industry by students studying construction subjects. The research within this study involved literature review and 12 qualitative interviews. The results revealed that there are campaigns to encourage women to join the constructions industry however there is still a stigma attached that the industry is scarred by discrimination, harassment, pay equality and stereo typing that are deterring females from offering greater diversity, new ideas and a solution to the skills shortage from joining the industry. On this basis, a culture change and new legislation clearing up the major issues within the construction industry needs to be completed prior to remarketing the image of the industry campaigning enabling females to join the sector.

Keywords: Discrimination, harassment, gender, skill shortage.

(Paper, ID 100)

Automation in Museum Construction and Operation

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Abstract. The conventional method in construction has many limitations and therefore needs modification. Not only is this method inefficient, but it is also harmful to the environment due to its high energy consumption. Therefore, there is a rising need for automation in construction. This need is accentuated in specific structures, such as museums, that are more creatively designed and have more specific maintenance and operation requirements. The purpose of

this paper is to create a tool kit for automating the design, construction, and operation of museums while considering sustainability measures. The main methodology is research on the application of Building Information Modeling (BIM), robotics, and 3D printing during the design and construction stages, and examination of the integration of the Internet of Things (IOT) and indoor air quality management into the operation stage. The results are workable guidelines for the automated museum. The tool kit is beneficial as it will save time and cost and increase the efficiency of operation. It will also increase awareness of the necessity of new job opportunities for labor within the technology sector.

Keywords: Automation, Sustainable Construction, Museum Construction, 3D Printing, Robotics, Internet of Things, Indoor Air Quality.

(Paper, ID 101)

Residential Construction Risk Management: Does it Happen in Real Life?

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Abstract. Risk management is a key component to successfully operating a residential construction company, whether it is a spec builder, custom home builder, or a specialized subcontractor. With each type of contractor, there are many risks which exist but differ greatly between each type of contractor. With differing risks and business strategies, methods of mitigation is also expected to vary. Research was conducted where several residential contractors were interviewed to discuss their businesses, most important risks, and their risk management process. This was an exploratory study and did not pose a hypothesis or test relationships between variables. This research presents the thoughts and habits of homebuilders as they relate to risk management. This small sample size is not sufficient to conclude with any confidence how a specific type or size of builder is likely to see and respond to identified risks but gives insights into the processes companies go through in evaluating risks, how they perceive certain risks, their response, and factors that go into the allocation of these risks.

Keywords: Residential, Risk Management, Custom Home Builders

(Paper, ID 103)

Assessment of the Role of Owner's Representative on Construction Performance: An Owner's Perspective

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Abstract. The modern construction industry is complex and heterogeneous. The three major players in this industry are: owners, constructors, and architects/engineers. However, there is a fourth party that can also be involved on construction projects: the owner's representative (OR). ORs are individuals or firms hired by an owner to manage the construction project in the owner's stead. They have a relationship contractor, architect/engineer, and the owner and provide a range of services depending on the needs of the owner. Given the important role ORs can play in this industry, there is a dearth of literature today concerning them, and extant literature is significantly biased with shortcomings including: authors' perspectives and overall lack of industry-driven data. The objectives of this research are to gain an understanding of when an owner is likely to hire an OR and what impact ORs have on project performance. This study placed a priority on remaining unbiased, and was conducted from the owner's perspective using data from projects with and without ORs.

Keywords: Owner's Representative, Construction Industry, Project Performance.

(Paper, ID 104)

STREBLO: The App Prototype for Managing Stress in the Construction Industry

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Abstract. High levels of stress at work, great responsibilities, hazards and lack of balance between tasks and deadlines are common in the daily lives of many construction workers. E-health applications can help manage stress. Accordingly, an App is being designed to enable construction workers to 1) detect the onset of stress quite early, 2) track their stress status, 3) empower persons to cope with stressful and/or demanding situations in an adaptive way, 4) improve and streamline the operability of job tasks, and 5) optimise efficient solutions for the construction industry. The development of this innovative app, known as Streblo, is part of a wider research that is studying stress

management in the construction industry. Streblo's blueprint will match personality traits with coping strategies in real-life situations. Its inputs are being generated from a field study that has commenced, where 23 structured interviews have been used to collect data from construction workers on their 1) personality and 2) behaviours while experiencing stress. Results of the data collection and analysis are being used to develop Streblo (an App) with IT experts. The paper reports the detail development and performance of Streblo's prototype. Ultimately, users will be able to engage Streblo on electronic devices (mobile phones, tablets, and computers) through both text and image-based communication, obtain real-time solutions and feedbacks on their stress status. Streblo will enhance and support attitude and behavioural changes in people who suffer from stress symptoms in the construction industry.

Keywords: Stress, Tool, Coping, App Design, Streblo, Well-Being.

(Paper, ID 105)

Water Conservation and Environmental Sustainability Approach

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Abstract. Water availability is finite over the world, which requires a controlled usage due to increased population, urbanization, and uneven population distribution. Domestic water usage is one of the major consumptive uses of water, which not only uses the precious water resource but also imparts considerable environmental effects through its carbon emissions in the installation and operational phases. Controlling domestic water usage can help reduce both water consumption and protect the environment. For this purpose, a case study was carried out, where an existing housing society (with fixed billing system) was compared to the metered water supply scheme of similar parameters. Water usage for the two societies was compared to assess the potential water saving, using a conservative assessment. The analysis included both installation and recurring works variables along with their carbon emissions. Suggested policy parameters, by introducing bylaws and other regulatory procedures, to be applied at all residential societies across Pakistan, have also been defined for enforcement of the water metering system. The results show that anticipated water conservation and enforcement of bylaws can not only preserve the precious water resource but can also reduce the carbon credits to help develop a sustainable approach.

Keywords: Water Metering, Water Conservation, Environmental Sustainability, Carbon Credits, CO_2 Emissions.

(Paper, ID 107)

Expectations from the Welding Curriculum Based on the Perspective of Engineering Technology Graduates in Nigeria

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Abstract. Welding engineering technology is a key driving force in the growth and development of industrial activities, with its application dominant in a wide range of industrial sectors including structural engineering, transportation, agriculture, healthcare and aviation. Welding activities demand adequate skills from welding personnel due to the high level of accuracy and precision required to produce quality results in finished products as well adhering to strict safety regulations involved in its processes. The quality of skilled welding personnel lies in their training and re-training to meet the continually evolving technology space. Students of higher education in welding are expected to be well equipped with the theoretical and practical skills to fit into the constantly evolving work space, a feat which can partly be attributed to the content of its curriculum. This research aims at highlighting the outcome and expectations of graduates, from welding engineering technology curriculum in Nigeria based on their experience and highlight the expectations from the welding curriculum and its effect on graduate employability. The survey results from 122 respondents who are graduates of welding engineering technology from the Petroleum Training Institute Effurun, Nigeria was analyzed with the mean item score (MIS) and factor analysis. Results from the analysis revealed that graduates expect to be employment ready and also get immediate employment from industry based on their acquired skills. The outcome of this research is expected to add to the body of knowledge aimed at improving the welding curriculum to meet the demands of industry.

Keywords: Curriculum, Graduates, Fabrication, Industry, Welding

(Paper, ID 108)

Perceptions of How Lean Practices Could Assure Quality in Construction

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Abstract. The construction industry is an industry with many problems regarding efficiency. One of those problems is the quality problem. The solutions to quality problem in construction projects are located in the application of lean construction. This paper outlines lean practices that can help contractors to produce quality products in the form of building and infrastructure. The empirical study was conducted using a quantitative approach. The study was undertaken in the Eastern Cape Province of South Africa where a semi-structured questionnaire was distributed to construction managers (CMs), construction project managers (CPMs), quantity surveyors (QSs), building contractors and civil engineers. The findings reveal that few professionals are aware of the concept of lean construction in their workplace. Lean construction not only affects the quality of projects, but affects other project parameters, and different factors have an impact on the quality of projects. More importantly, there is no evidence of the adoption and use of lean tools and techniques in the industry. The aforesaid perceptions suggest that the industry have to explore how to use lean construction principles, tools/methods and techniques for improved performance in the sector.

Keywords: Construction, Contractors, Lean, Projects, Quality.

(Paper, ID 109)

The Sources of Dispute in Construction Projects in the Mpumalanga Province

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Abstract. Construction projects are frequently held in a complex and uncertain nature, alongside claims being unavoidable. Construction projects involve processes that are complex and dynamic which at most result in disputes between the stakeholders. The study investigated the sources of disputes in construction projects in the Mpumalanga Province. The data used in this paper were derived from both primary and secondary sources. The secondary data was collected via a detailed review of related literature. The primary data was collected through a survey questionnaire which was distributed to project participants. Out of the 90 questionnaires sent out, 80 were received back representing 89% response rate. Data received from the questionnaires were analysed using descriptive statistics procedures such as Ms Excel and SPSS software. Findings from the study revealed that; payment delays, poor supervision financial incapable of contractors, change of scope, delay in work progress, poor workmanship, incomplete specification design errors, delay in providing information and extension of time were the main sources of construction disputes. Therefore, client should minimise changing scope to avoid cost overrun and extension of time which contribute to dispute. Respondent believed that dispute avoidance strategies such as stakeholders management, alliancing, lean construction and partnering will reduce dispute drastically. Hence, the industry is encouraged to embrace modern management concepts and to avoid the effects of construction disputes such as loss of production, delays, profitability.

Keywords: Construction Industry, Claims, Disputes and Mpumalanga Province.

(Paper, ID 110)

Rethinking the Application of Computer Assisted Mass Appraisal for Property Valuation in Johannesburg Municipality.

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Abstract. In the last decade, mass valuation system is applied in City of Johannesburg in addition to individual valuation system for rates and taxes. Property valuation in Johannesburg for rating purposes are governed by the Municipal Property Rates Act No.6 of 2004, as amended, the Act provides that all real property shall be valued at marketplace value, which is the price that a property would have sold for in open market between willing parties on the valuation date. Following years of manuals rating procedure, South Africa finally adopted the Computer Assisted Mass Appraisal (CAMA) over 2 decades ago. It employs a technology named Value Assists; however, the potential deliverables of the innovative approach are not realized. The rate of objections to property tax is alarming and continually

growing after each general valuation roll. This paper presents a review of the application of CAMA and the present challenges in Johannesburg municipality with a view to chatting the way forward to the adoption of the best practice.

Keywords: Mass appraisal, Taxation, Value Assist, CAMA

(Paper, ID 111)

The Influence of Clients and Designers on Construction Health and Safety (H&S)

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Abstract. A South African construction industry H&S status report cited the high-level of non-compliance with H&S legislative requirements, and attributes it to a deficiency of effective management and supervision of H&S on construction sites as well as planning from the inception / conception of projects within the context of project management. The study reported on constitutes a further phase of studies to assess the status quo relative to the role of clients and designers in construction H&S. A self-administered survey was conducted among delegates attending a 'Baseline Risk Assessment (BRA), Designer Report, and H&S Specification' workshop on the second day of an Association of Construction Health and Safety Management (ACHASM) two-day Summit. The salient findings include: the client and designer requirements of the Construction Regulations are vindicated, and clients and designers can and do influence construction H&S. Conclusions include: training can and does influence delegates' construction H&S culture; clients and designers influence construction H&S, however, it can be in a positive or negative manner; the client and designer-related requirements of the Construction Regulations are vindicated, and clients and designers must be empowered to contribute to construction H&S. Recommendations include: clients and designers should follow the requirements of the Construction Regulations, and property development and designer-related tertiary education must include, or rather embed construction H&S in their programmes.

Keywords: Clients, Construction, Designers, Health and Safety.

(Paper, ID 112)

A Framework for Managing Building Construction Technology for the Campus Owner through a Building Design Sustainability Safety and Maintainability Assessment System

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Abstract. The design of modern buildings must account for constructability, buildability, sustainability safety and maintainability. At present, these concepts are tracked and applied in an uncoordinated way and the resulting missed opportunity for increased resource usage is not realized. The research proposes a framework for a coordinated application of these concepts for the campus owner.

Keywords: Constructability, Buildability, Sustainability, maintainability, Safety.

(Paper, ID 113)

Safety Management Amongst Small Contractors in Selangor, Malaysia

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Abstract. Safety management system (SMS) incorporates direction on the safety, guideline and documentation, safety preparing, crisis readiness and also reaction arrangement and safety approach. It is an important element to be implemented in the construction industry. Therefore, it is important for the small contractors to develop, implement and maintaining the safety management system in their project. This paper aims to identify the safety management system amongst small contractors in Malaysia. Questionnaires survey was sent out to 100 small contractors of Grade G1 registered under the Malaysian Construction Industry Board (CIDB) with a thirty-five (35%) returned. As a results, it was found that the problems occur in construction sites were improper controls machine, inadequate maintenance, unsafe of employee attitudes, unsafe conditions of materials, plants and equipment, ineffective of training of instruction, use of alcohols and drugs, lack of communication, improper motivation of operational personnel as well as improper safety rules and guideline. It is recommended that the small contractors

should implement the safety management techniques or procedures during the construction to avoid and control the risk and need to develop and conduct the safety training programmes and training policy for the workers on the site. They must provide an adequate Personal Protection Equipment (PPE) for workers on site for protection and prevent from risks and accidents which may occur during construction operation.

Keywords: Safety Management, Small Contractors

(Paper, ID 115)

Assessing the Emerging Factors on Stakeholder Management in Public-Private Partnerships (PPP) in Malaysia

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Abstract. Public Private Partnerships in Malaysia has become popular to both public and private sectors. Private and public sector need to know the emerging factors attaining the successful delivery of stakeholder management in PPP projects. This paper aims to identify the emerging factors affected the success delivery of stakeholder management in Malaysian PPP projects. In order to achieve the objectives, the data presented are includes of qualitative interviews, observations, anddocumentary reviews of documents related to selected case studies. Nine (9) PPP projects were selected Malaysian highway projects. Results shown that there were seven (7) emerging factors of successful delivery of stakeholder management in PPP projects. These factors include the key drivers of stakeholder management, good stakeholder engagement, built trusts between stakeholders, understanding concession agreement, bankability/ availability of financial, technology transfer, fast completed and earn revenue and fast decision making. It is recommended that these seven (7) factors are considered as the keys to successful delivery of stakeholder management in PPP projects. These factors expected to be guidelines to all stakeholder involved in achieving successful delivery in PPP project in Malaysia.

Keywords: Public-Private Partnerships (PPP), Stakeholder Management.

(Paper, ID 116)

BIM Awareness and Usage VS BIM Knowledge, Importance and Future Planning: An Analysis from Malaysian Quantity Surveyors

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Abstract. The construction industry has been continuously affected by the inefficiencies and ineffectiveness in delivering its construction projects. However, BIM technology has been acknowledged to have numerous benefits in contributing towards project success. The BIM benefits include reduced project time and cost; enhanced team collaboration and communication; and improved project quality and performance. In quantity surveying practice, BIM applications also provide a platform towards producing more reliable cost estimates. However, its usage amongst the Malaysian Quantity Surveyors is still at infancy level. Thus, this paper aims to explore BIM implementation amongst the Quantity Surveyors in Malaysia. A questionnaire survey was conducted to gain their perspectives on BIM awareness and usage, versus the knowledge, importance and future planning of using the technology. The overall results show that the respondents have rated themselves as having moderate knowledge in BIM. For BIM could play a major role in their practice, they would apply BIM for their future planning. This study significantly offers input for BIM adoption in the Malaysian construction industry by focusing on the quantity surveying field. Subsequently, the information could be used as a reference to benchmark BIM development in Malaysia.

Keywords: Building Information Modelling (BIM), BIM awareness, BIM knowledge, Quantity Surveyors, Malaysian contruction industry

(Paper, ID 117)

Augmented Reality (AR) for Utility Infrastructure: An Experiential Development Workflow

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Abstract. The process and product development phase of the research instrument for experiential action research is crucial in the success of the research. Due to time, space and resource limitations, fewer studies have concentrated on this development process. In this respect, research on Augmented Reality (AR) in the architecture, engineering and construction (AEC) industry is no exception. This is more evident in subsurface, urban utilities and infrastructure sector. Furthermore, a limited number of studies on AR/VR have utilized mobile devices as their enabling technologies. This paper sets out to contribute to the state-of-the-art in AR research for urban utilities and infrastructure by outlining a generic procedural workflow to be used for designing AR experiments for experiential research in this area. Given the fact that workflow development research in AR is still limited, this research presents a unique contribution in this area to date.

Keywords: Augmented Reality, Construction Industry, Handheld Devices, ICT Application, Infrastructure, Urban Utilities.

(Paper, ID 118)

Augmented Reality for Urban Utility Infrastructure: A UK Perspective

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Abstract. Research on Augmented Reality (AR) in the architecture, engineering and construction (AEC) industry is still new. As part of a comprehensive study on the application of AR technologies for urban utility infrastructure, this paper sets out to contribute to the state-of-the-art in this area by presenting the results of an industry survey in the UK. The results of the survey conformed, in principles, to majority of findings of the previous research in the field, but also revealed some new or contradictory patterns. Geo-locationing and geo-tagging are still major concerns and have not yet been completely resolved. Relying on global systems does not look like the most reliable option and local systems are required to either replace or jointly work with global systems. With respect to non-AR issues, it is crucial that the quality and content of infrastructure and utilities data are improved and ideally stored centrally in a nationally-procured database.

Keywords: Augmented Reality, Construction Industry, Handheld Devices, ICT Application, Infrastructure, Urban Utilities.

(Paper, ID 119)

Sharing Knowledge Via Ubiquitous Technology to Enhance Safety Awareness: Willingness and Actual Experience in Hong Kong

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Abstract. Recently, various ubiquitous technological advancements have benefitted knowledge sharing in different sectors. As there is a close relationship between safety knowledge and awareness, this paper examines the use of Web 2.0, Internet of Things (IoT), and mobile applications in construction safety knowledge sharing for enhancing safety awareness at work. The use of such technologies can improve internal and external communication as well as collaboration. A quantitative survey was conducted to investigate the willingness and uptake of advanced technologies in the Hong Kong construction industry. Out of 23 respondents, 16 were eager to use mobile applications to share safety information. Regarding safety knowledge sharing via Web 2.0, respondents perceived a variety of barriers for not using it, such as the need to protect their company's privacy issues made them hesitant to share knowledge regarding safety issues; others were of the opinion that Web 2.0 was managed by the elite in the organisation. Only one respondent claimed to have used the technology before, however, without specifying how he made use of it. The willingness to apply IoT was relatively negative due to the perceived extra operation costs.

Keywords: IoT, Mobile Apps, Web 2.0, Knowledge Sharing, Construction Safety

(Paper, ID 120)

Measuring the needs for the Special Property Development Entity (SPDE) for Waqf Property Development in Malaysia

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Abstract. This paper aims to enhance the approach for developing the waqf properties in Malaysia. A Special Property Development Entity (SPDE) in the context of this article refers to a dedicated development actor that holds the responsibility to develop waqf lands. The intended role of the SPDE is to become the property development arm of State Islamic Religious Councils (SIRCs) in developing the waqf lands. This is expected to overcome the current limitations of SIRCs in entering into the property development while bringing a new model to deal with the issue of undeveloped waqf lands, as well as a better platform to penetrate the property market. The objective of this article is to measure the needs for the establishment of SPDE by SIRCs. By adopting a structured interview technique with fourteen informants from SIRCs throughout Malaysia, the study was able to quantify the needs for the SPDE. The quantification process for the need to establish the SPDE was conducted using the Guttman Scaling, which galvanises the need for versatile SPDE in contribute to the waqf institution.

Keywords: Special Property Development Entity (SPDE), Waqf Institution, Property Development, Malaysia.

(Paper, ID 121)

Assessing the Intrinsic Value of Construction Stocks: An Empirical Evidence from the Price Earning Models

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Abstract. The encouraging performance of Malaysian construction industry requires a holistic understanding of the intrinsic values in order to practically invest in this sector. The paper aims to assess the intrinsic values of Malaysian construction stocks using price earning-valuation models. Quantitative content analysis has been employed to the top 20 construction companies based on total market capitalisation identified as Malaysian Construction Company (MCC) 1 to MCC20. Based on the data derived from the Bursa Malaysia, annual reports and stock-related websites, the intrinsic value of the construction stock is assessed using two fundamental methods of valuation comprising Price Earnings Multiple and Relative Price Earnings. The results suggested that there is a positive consistency of intrinsic values across two methods of valuation where 11 MCCs were recorded as undervalued stocks, 4 MCCs recorded as overvalued and 2 MCCs recorded at fairly valued in relation to its stock opening prices. Only 3 stocks recorded inconsistent findings where the Relative P/E were unable to effectively countercheck the intrinsic values derived from P/E Multiple. Overall, the results literally suggest that the 20 MCCs are lies within the semi-strong form of market efficiency. This research is expected to provide preliminary evidence on the intrinsic values of construction stock in relation to the existing market efficiency.

Keywords: Construction Stock, Intrinsic Values, Price Earning Models.

(Paper, ID 122)

Deployment of Building Information Modelling (BIM) for Energy Efficiency in the UK

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Abstract. Continuing advancement in digitalised technology has brought about constant changes and innovations in several industries. In consttruction, Building Information Modelling (BIM) is one of these key technologies that seeks to lessen the impacts of global warming and growing environmental concern. BIM also positively contributes in sustainable life-cycle decisions for building procurement and management. The dynamic digital environment provided by BIM facilitates the effective storage, sharing and integration of all the essential building information throughout the entire life-cycle of a building within a three-dimensional computer model. Despite the major technical opportunities and benefits, however, BIM has not been fully adopted and capitalized upon yet by industry stakeholders worldwide. The lack of widespread uptake engaging all team members and more practical and

achievable policies and other initiatives, substantial cost of software equipment, high training and consultancy fees, personal user behaviour, mostly regarding difficulties in changing traditional work processes and other factors represent the major barriers impeding the full BIM-productive potential which leads to many drawbacks, such as lower performance in building`s energy efficiency and qualitative properties, higher cost, resource losses, delay in time for project completion. To this end, some interiews were conducted for the purposes studying the sustainable ways of using BIM and the dissemination of its adoption in planning, consulting and contracting companies and organisations in the UK was conducted in this research. A more feasible integration of BIM for energy-simulation, but there are still many gaps to be fulfilled. Although UK-based companies appear to be willing to implement BIM, in real terms it is more likely that BIM is not being used in its full potential.

Keywords: Building, Energy Efficiency, Refurbishment, Sustainability, BIM

(Paper, ID 123)

Project Control Through Disincentivisation: A Case Study of Hong Kong-Zhuhai-Macau Bridge Project

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Abstract.
Incentives and disincentives (I/D hereafter) arrangements have been regularly used as project control measures. Incentives aim to enhance performance through reward provisions whereas disincentives penalise performance below agreed targets. Use of Incentives are based on motivation theories and has been well recognised as catalyst for performance. Disincentives are relatively less studied even though it is also commonly used to deter underperformance. Compared with incentives, disincentives are less costly and can function well when monetary reward is not the sole performance motivator. This proposition is discussed and illustrated through a case study on the Hong Kong Zhuhai Macau Bridge (HZMB) project. In the HZMB project, disincentivisation was integrated with the Reputation Evaluation System (the System hereafter). The System has four parts: 1) Goal Commitment; 2) Reward/Responsibility reallocation; 3) Monitoring method application and 4) Performance Assessment. Through focus group discussions, it is found that 1) The System is a useful project control tool; 2) The desire to maintain reputation underpins the effectiveness of The System; and 3) The System is instrumental in relationship building. Disincentivisation is effective in the HZMB when it is linked with the performance status of the contracting organisations. The importance of maintaining reputation in signature projects like the HZMB makes disincnetivisation a less costly and viable project control measure.

Keywords: Hong Kong-Zhuhai-Macao Bridge; Disincentives; Project Control, Project Performance.

(Paper, ID 124)

Relating quality of Service to Customer Satisfaction in the Nigerian Automotive Service Sector

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Abstract. Service quality and customer satisfaction are two management concepts that have transformed the operational productivity and competitive standards of businesses across industries. While several operational strategies are developed as a result of these two concepts, operational productivity will depend on the effect on specific quality attributes that influences the consumer's judgment on their service experience. In developing countries, where unstructured and unregulated business practices sum up the characteristics of the automotive after-sale industry, it is then difficult for service providers to employ operation strategies developed to only suit structured business organizations. Instead, a customer approach provides a simplified approach to improving operational productivity. This study evaluates the relationship between service quality and customer satisfaction in the Nigerian automotive industry in a bid to recognize the perception of auto-repair clients through their service experience(s). Primarily focusing on four-wheeled automobile maintenance services, 200 respondents were obtained from passenger vehicle owners and make patronize auto-repair operators in Lagos state, Nigeria. Quantitative data analysis employed a mean item score, and regression analysis. The findings revealed that while service quality related to satisfaction, attributes such as empathy, reliability and assurance were responsible for their relationship. This studies outcome intends to create awareness for quality parameters that improve productivity and spark more discussion on the applicability of these service concept in the Nigeria automotive after-sales sector.

Keywords: Service Quality, Customer Satisfaction, After-sales, Vehicle Repairs.

(Paper, ID 125)

Evaluating the Influence of Training on Attitudes to Building Information Modelling (BIM) Adoption in Malaysian Construction Industry by using Extended Technology Acceptance Model (TAM)

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Abstract. The adoption of Building Information Modelling (BIM) as technological advancement in the construction industry has become a main concern among its stakeholders. Research and expert advice have claimed that the BIM adoption rate can be increased by giving an in-depth understanding in the importance and benefits of BIM implementation. Training is one of potential factors that could expedite the adoption of BIM. BIM training is a significant aspect in BIM implementation due to its role not only to expand the knowledge, but also as a means of facilitating BIM adoption. Therefore, the aim of this dissertation is to investigate the influence of BIM training on attitudes to BIM implementation among Malaysian construction players by using extended technology acceptance model (TAM). The beliefs of ease of use, usefulness and employee resources were utilised as TAM variables for explaining the relationships between training variables and behavioural intention to use. In order to achieve this aim, an online survey was conducted among professional employees of government agencies. The findings demonstrated that extent of training was not related to TAM variables suggesting that a high amount of training would not positively affect the BIM adoption. In addition, TAM variables had significant positive relationships with behavioural intention to use. Finally, this study suggested the perspectives of ease of use, usefulness and employee resources should be taken into consideration by training organisers in organising BIM training in order to create an effective training that can facilitate BIM adoption.

Keywords: Building Information Modelling(BIM), BIM Training, BIM adoption, Extended Technology Acceptance Model

(Paper, ID 126)

Multi-Objective Resource-Constrained Scheduling in Construction Projects

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Abstract. The resource-constrained scheduling problem (RCSP) is one of the most challenging problems in project management. It is a combinatorial optimization problem with multiple and contradictory objectives (resource allocation within resource availability levels, project completion prior to a given deadline, resource leveling throughout the project length) and constraints (precedence constraints between activities) while its complexity grows as the number of activities increases. In this study, the objective function includes a number of sub-objectives that result from practical considerations of actual construction projects. These are the cost of daily resources exceeding the resource availability, the cost from the day by day resource movement in and out of the project work, and the cost of prolonging the project duration or exceeding the project completion deadline. Due to the large solution space size (even for a small-sized project), genetic algorithms are employed in this study to develop the optimal or a near optimal solution. The model is applied on a case study project and tested for different constraints and goal scenarios, in order to provide insight regarding the effectiveness of the method in different optimization criteria and project management priorities. Evaluation results indicate that the proposed approach can effectively approximate the optimal solution in all cases.

Keywords: Resource-constrained scheduling, Resource allocation, Resource leveling, Multi-objective optimization, Genetic Algorithms

(Paper, ID 127)

Contingency Use and Project Delivery Influence on Infrastructure Project Risk Assessment

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Abstract. Risk assessment and management in infrastructure projects considered one of the main factors that can enhance project success. Project team perceptions on risk identification are important to develop a risk mitigation strategy. Cost overruns are one of the critical risks in this industry, which have been mitigated by allocating a contingency amount to the initial cost estimate. The aim of this study was to understand the use of project contingency by the owner and contractor. Additionally, it analyzed the project delivery methods that entice the use of intensive project risk assessment procedures, especially in infrastructure construction projects. It was found as one of the factors that drive the use of risk assessment.

(Paper, ID 128)

Investigation of Electronic Document Management applications in the Construction Projects: Case Study in Jordan

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Abstract. Document Management System (DMS) is always known to be vital for management of the complexity of construction projects. This study aims at investigating the opinions of DMS practitioners regarding the use of Electronic Document Management System (EDMS) in construction projects. A questionnaire survey was conducted with 91 respondents involved in the construction projects. The respondents were asked to evaluate the extent, motivations and challenges of applying EDMS in the construction projects in Jordan. According to the survey results only 8.8 % of the respondents described the document system in their construction projects as mostly electronic, while 38.5% described their document system as using almost similar percentage of electronic and paper-based documents. The results also showed that the top motivation to the application of EDMS in the construction projects is the improvement of search and retrieval of information, while the top challenge is the high expected financial cost of EDMS. This study helps to evaluate the existing DMS, and investigate the motivations, challenges and opportunities to improve EDMS implementation and application in the construction projects.

Keywords: Document Management, Construction Management, Construction Projects, Electronic Document Management System.

(Paper, ID 129)

Current Status of Awareness and Readiness Towards Building Information Modelling (BIM) Among Sri Lankan Quantity Surveyors

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Abstract. BIM gets people and information working together effectively and efficiently through defined processes and technologies. Therefore, BIM is widely promoted in both developed and developing countries as an emerging enabling technology. BIM has the potential to influence everyone's professions in the construction industry in different ways. For Quantity Surveyor (QS), BIM has the potential to remove many mundane elements of traditional quantity surveying, such as manual quantity taking off (QTO) replacing automate QTO, which increases the efficiency and collaboration.
Hence, several authors have stated in their work that BIM is a Buzzword for the Sri Lankan construction industry. Nevertheless, there are no statistical figures regarding the application and implementation of BIM among the construction players. Therefore, the aim of this paper is to investigate the current status of BIM awareness and readiness of QS's and large-scale quantity surveying firms in Sri Lanka. The research engaged with a questionnaire survey and semi-structured interviews among Sri Lankan quantity surveyors and quantity surveying organizations. The data was analyzed statistically using statistical analysis. This research will be limited to large-scale quantity surveying firms in Sri Lanka.
The results indicated that BIM is not a buzzword for the Sri Lankan construction industry anymore, as there are organizations who have already adopted BIM. Most of the large-scale quantity surveying organizations have already started using BIM and experiencing the benefits of it. Therefore, it can be concluded that Sri Lanka has reached BIM level one. The organizations who are using BIM, seeking to develop it furthermore by achieving BIM level 2. However, the majority of quantity surveying organizations are still not using or not in the process of implementing BIM. Unidentified barriers buried the acceptance of BIM into their organizations. Therefore, identified barriers and BIM adoption framework will accelerate the adoption of BIM into quantity surveying firms in Sri Lanka.

Keywords: BIM Awareness, BIM Readiness, Quantity surveyors, Quantity surveying organizations, Sri Lanka.

(Paper, ID 130)

Exploring individual adaptability as a prerequisite for adjusting to technological changes in construction

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Abstract. The advances in globalisation and technology have had significant impacts on the work environment, as they make various jobs more dynamic and fast-paced. Adaptive employees have become essential ingredients for

organisations' success. Changing technologies such as digital transformation and automation require employees to adapt to new ways of working. This study considers the reactive approach of individual adaptability, which is seen as modifying one's behaviour to meet the demands of a new situation, event or a changing environment. Other definitions suggest that adaptive performance can be proactive to the anticipated future changes in the environment. The study employed an exploratory research approach to understand the concept of individual adaptability to technological changes in construction organisations. It involved semi-structured in-depth interviews with three top management professionals and four construction workers from four different firms. These organisations were selected based on their number of employees, main construction business as contractors, and investments towards technological changes. The findings indicated that individual adaptability is a performance construct instead of a personal characteristic. Workers are not involved in the decision-making processes regarding technological changes. Furthermore, the difficulties in implementing technological changes mainly consist of changing the mindset of workers who have used the same method for a long time and a lack of investment in innovation methods. The study identifies leadership, experience and open-mindedness as the predictors of adaptation to new technology. Workers consider learning through training as adaptive behaviour in technologically advanced environments. We propose future empirical studies on adaptability and trainability.

Keywords: Adaptive Behaviours, Technological Change, Exploratory Study.

(Paper, ID 131)

Undesired Contractual Behaviour of Key Participants in Civil Engineering projects

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Abstract. The most important key participants in a construction project are the integration between different entities comprising clients, the multidisciplinary consultants (architect, engineers, surveyors) and the contractors. Thus, the contract is needed to protect the contracting parties against opportunistic behaviour and other risks in business relations besides to govern the project implementation in achieving the project goals. Unfortunately, literature has replete with the problems rendered in construction projects caused by the behaviour of key participants who do not duly adhere to the contract in the project implementation. Therefore, this paper aims to identify the common undesired contractual behaviours of key participants in civil engineering projects which largely reported as one of the major factors affecting the project performance. 288 feedbacks received out of 700 questionnaires distributed to the G7 CIDB registered contractors and professional engineers registered under the Board of Engineers Malaysia. Descriptive analysis and Mann-Whitney U test were used in data analysis. The findings revealed that among the seven (7) undesired contractual behaviours investigated in this study, the delay in making payment was ranked as the highest occurrence followed by the delay in work progress, delay in issuing drawings and information and delay in site possession. Poor communication and unauthorised instruction were considered as moderate while client direct instruction was a very low occurrence in civil engineering projects. In the attempt to observe the performance of civil engineering projects in Malaysia, the four high occurrence contractual behaviours are critical to be put more concern.

Keywords: Civil Engineering, Contractual Behavior, Contract, Project Performance.

(Paper, ID 132)

Modular versus Conventional Construction: An Analysis of Cost and Benefits via a Case Study

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Abstract. This paper presents a broad analysis of the cost and benefits of the two main construction methods currently in use in North America - the conventional construction and the modular construction. The main goal is to provide a cost estimate of the implications of both construction methods for low-rise apartment buildings as well as to determine which one is more cost effective. The methodology consists of a qualitative analysis that outline the benefits of each construction method over the other, and a quantitative analysis that compares the cost of the finished building per square foot. Both analyses are conducted by evaluating a case study of a five story low-rise senior residential building with similar characteristics, one built using conventional method and the other built hypothetically with modules. The benefits identified for conventional low-rise building include later design

changes, easy to understand for investors, less logistics, and easy to manage. On the other hand, the benefits for modular low-rise are higher quality control, less on-site work and less on-site trades. The quantitative results show that the modular construction method is only marginally more cost effective than the conventional construction method under the same circumstances. Through the proposed method, the contractors and developers can assess the cost effectiveness of the two construction methods for low-rise residential apartment projects to make informed decisions.

Keywords: Conventional Construction, Modular Construction, Construction Costs, Prefabrication, Decision Making.

(Paper, ID 133)

Academic Satisfaction and Career Preparedness: An Exploratory Study on the Perceptions of Construction Management Graduates

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Abstract. When students graduate from higher education, their objective is to gain employment in a field of study where they can utilize the skills they have obtained. Many Construction Management programs are designed to encompass within four years, as much academic knowledge and training pertaining to the construction industry the program is designed around. However, there is often a disconnect between what is taught in the curriculum and the skills that is valued in the workplace. Many higher education programs want to know whether their program provides the necessary skills for their students' success. Students' satisfaction is one major indicator of their success and by conducting a survey of the students' satisfaction level in relation to their education and job, programs often define areas that need improvement so they can create the best possible learning environment for the students. The objective of this research is to discover whether the Construction Management program is meeting the needs of its students. With this knowledge, the Construction Management program can address the areas that may require further development, making the program more satisfying for current and future students.

(Paper, ID 134)

Land-Use Optimization Based on Transit Oriented Development with Linear Programming

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Abstract. The large-scale and continuous increase in the number of urbanization make the daily needs in urban areas more diverse and significantly following to increase. The basic needs become the main thing to make the stability and survival of the city area that must get support from the surrounding environment. The concept of transitoriented development (TOD) is present to help the direction of the urban development program. The main problem is how to determine the priority function or designation of an urban area effectively. This research tends to attempt the function optimization in the urban area so that the infrastructure development can support urban progress effectively. Research began with qualitative methods which validation is the analysis rule in the city development variables as a result of literature studies. The results of the validation are input to the Linear Programming analysis process which it is a quantitative method. There are five types of property that become the main property development priority to support the ridership effectiveness of infrastructure development with the TOD concept. The study took a case study in a developing country region that recommended office, residential, and retail functions which are the three functions having the greatest influence on the development of the TOD region that is in line with the region's potential. The number of ridership improvement in the case study reached 55% which the model recommended in this study.

Keywords: Transit-Oriented Development (TOD), Land-Use, Transit Ridership, Optimization Process.

(Paper, ID 135)

An Overview of Onsite Residential Sewage Disposal and the Implications on Underground Water Supply and Health in Nigeria.

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Abstract. A residential housing is normally designed to serve the immediate need of human activities. Usually, provision for collection and disposal of sewage is a priority to enhance a healthy living environment. The millennium

development goal on human health remains unrealistic in many developing countries due to poor disposal of sewage. Using a combination of primary and secondary data this study presents an overview of onsite sewage disposal and its impact on underground water and health issues in Nigeria. Findings show that onsite septic tank is the main method of sewage disposal. An average of 5 metres was observed between the shallow dug well and septic tank. Hence, the underground water is highly susceptible to contamination but remains the primary source of domestic water supply. Reported cases of cholera traceable to fecal contamination of underground water remain very high. This paper argues for the involvement of professional in the building industry to present a proposal for a central sewage system particularly where the risk of infiltration of sewage into the water body is high.

Keywords: Housing, Sewage, Septic Tank, Disposal, Health, Policy

(Paper, ID 136)

Critical Factors Influencing the Bid/No Bid Decision in Pakistan Construction Industry

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Abstract. In construction industry, adequate and effective decision-making can mean the difference between success and failure. Bidding is the most important element of construction business since it is a mean by which contractors obtain work. This is probably the only option for any contractor firm to sustain in the market and achieve its objective of earning the profits by winning tenders. The capability to select most appropriate ventures not only defines the success and wellbeing of a contractor firm, but even its survival and sustainability in the industry. This research has been opted considering the local construction industry of Pakistan in order to examine the critical success factors from contractors' perspective while making bidding decisions, listing and evaluating critical factors in order of their importance. Literature review and questionnaire are used for identification and quantification of factors affecting bid/no bid decision-making. Statistical methods of ranking analysis were used for analysis. It is found that profitability, need for work and financial health of client are the most decisive factors in bid/no bid decision-making while project size, project type, fulfilling the tender conditions imposed by the client and relationship, identity & reputation of client are least impact factors in bid/no bid decision-making.

Keywords: Bidding, Bid decision-making, Construction procurement, Contractor.

(Paper, ID 139)

Green Building Retrofitting in the UAE

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Abstract. The UAE went through a huge building boom in the last twenty years, resulting in extensive useful infrastructure, yet not necessarily all was built with green design parameters in mind. As these buildings reach their retrofitting milestones, it is an opportunity for owner/developers to retrofit the necessary components for improved energy efficiency and reduced carbon footprints. Thus, this paper summarizes the rationale behind the basic elements identified in a study to develop a green retrofitting toolkit for commercial buildings in the United Arab Emirates. The study focused on refurbishing the passive systems, such as the building envelope (wall enclosures and roofs), and the active systems (lighting and HVAC systems). The methodology that was followed involved looking at the purpose of retrofitting a building for each criterion and examining the necessary issues to be considered, as well as providing the optimum solutions along with a performance matrix for the UAE climate in terms of energy and cost savings. Moreover, a Revit based model was used on a prototypical commercial building design to assess the energy efficiency and resultant cost savings. The study emphasized an all-inclusive retrofitting approach.

Keywords: Green Buildings, Retrofitting, UAE, Toolkit, Passive and Active Systems Design.

Royal Institute of Chartered Surveyors (RICS) Information

12, Great George St, Westminster, London SW1P 3AD
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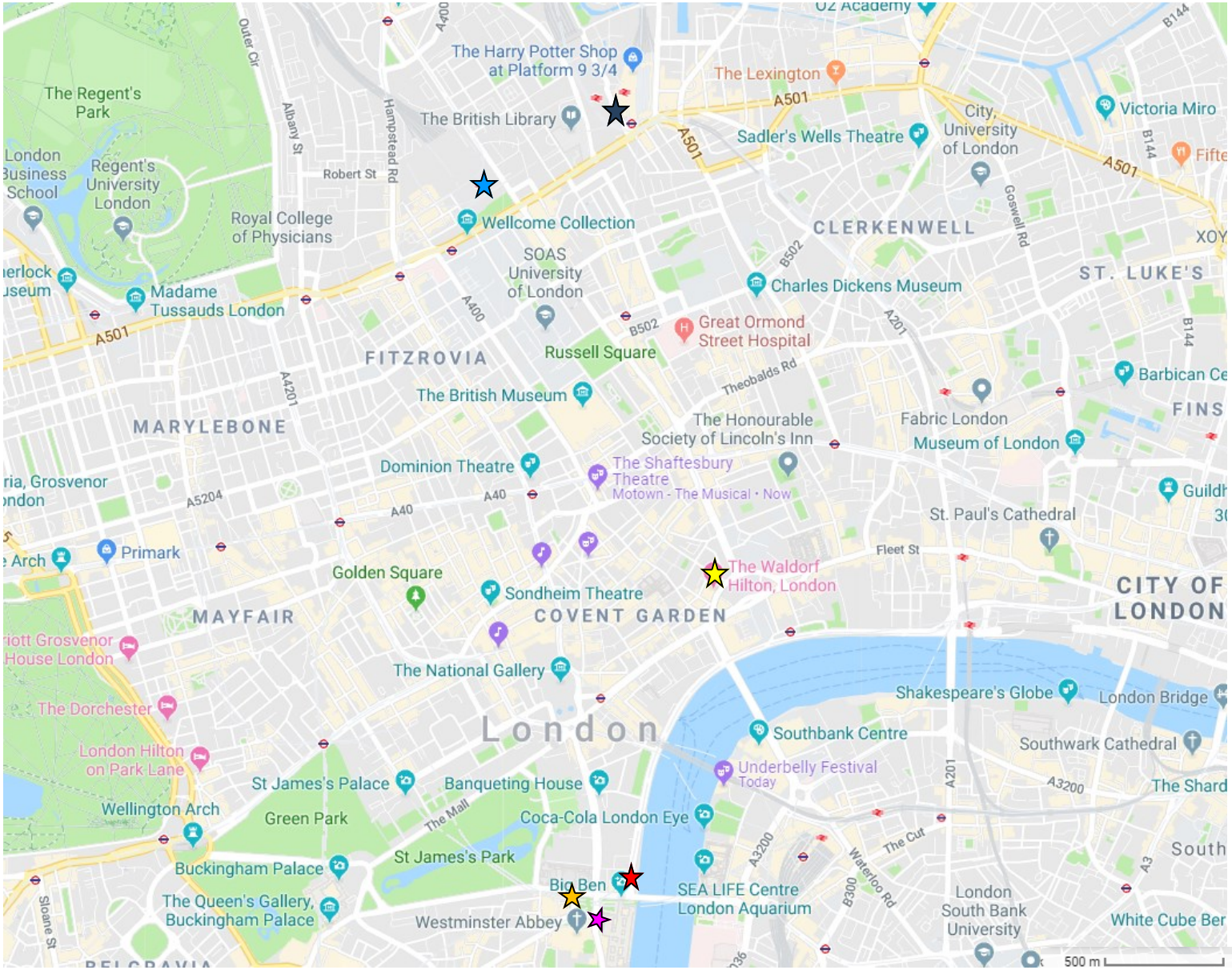
Welcome Reception

The Waldorf Hilton
Aldwych, London, WC2B 4DD, United Kingdom

Adelphi Suite 1

1:45pm	**Welcome drinks and refreshments**
2:20pm	**Welcome** Dr Paul Hampton University of Wolverhampton
2:25pm	**Welcome Speech** Caroline Gumble Chief Executive of CIOB
2:45pm	**Networking and drinks**
4:00pm	**Closing remarks**

CITC11 Conference, London, 9th—11th September 2019



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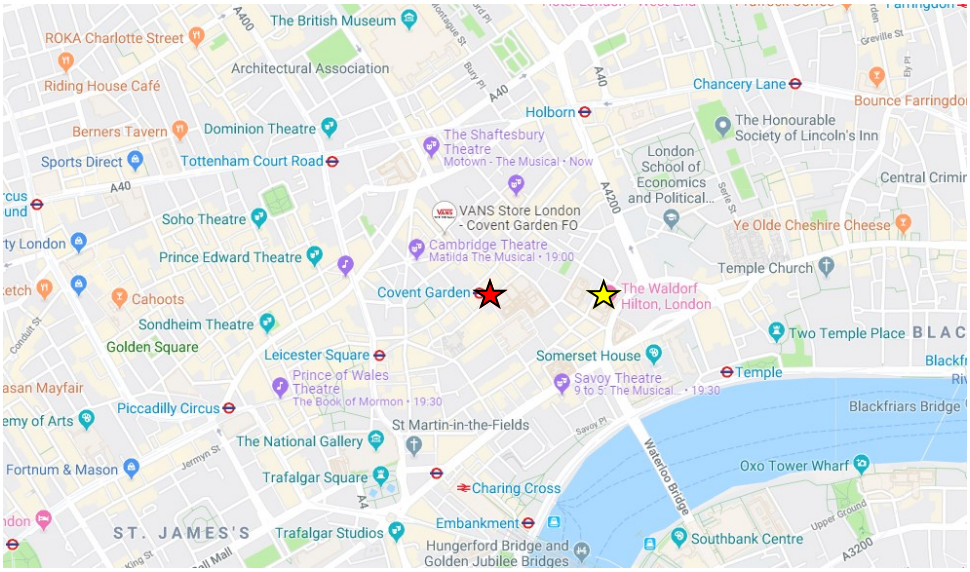
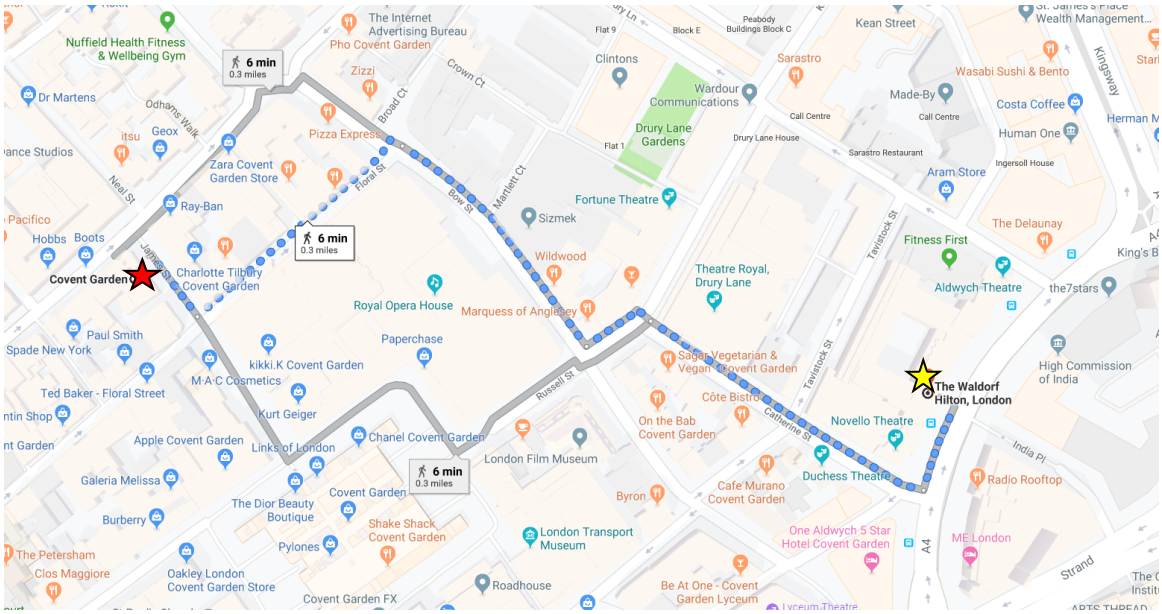
CITC GLOBAL
Construction in the 21st Century

8th September 2019: CIOB Welcome Reception, The Waldorf Hilton, 2pm.





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King's Cross St Pancras: take the Piccadilly Line to Covent Garden (5 minutes).

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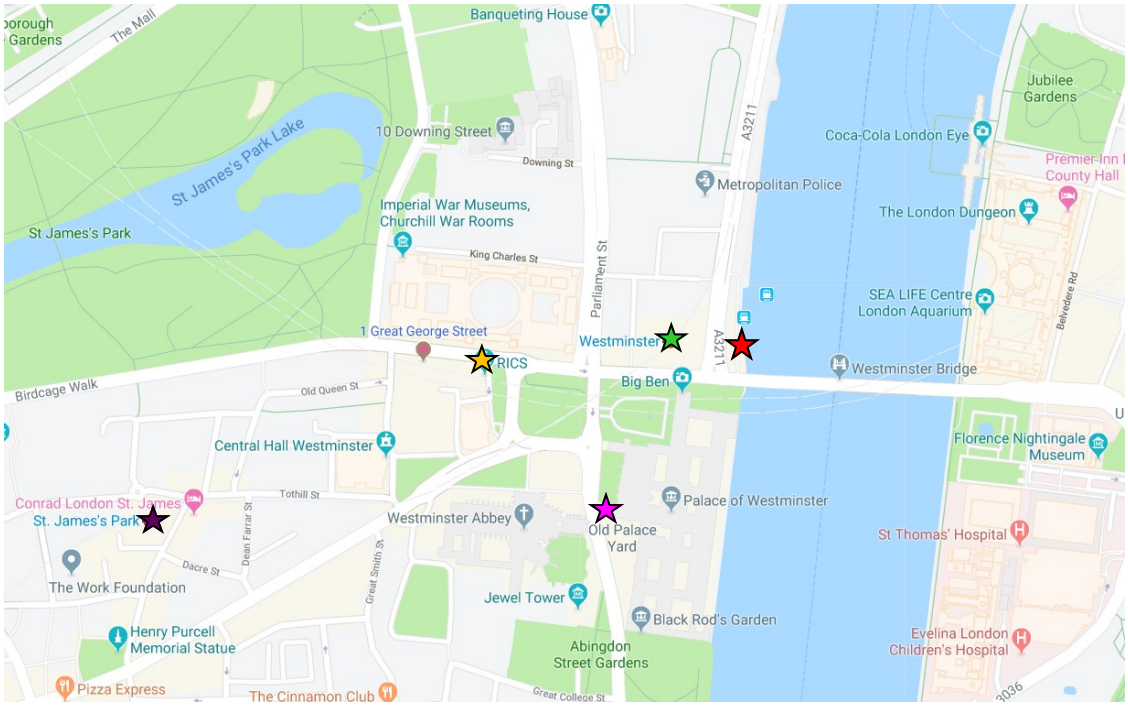
Construction in the 21st Century

9th, 10th & 11th September 2019: Academic & Industry Conference, RICS Headquarters, 9am



- RICS HQ
- Westminster Underground Station
- St James' Park Underground Station
- Meeting point for River Cruise
- Cromwell Green Visitors Entrance, House of Commons

9th—10th September: Conference & River Cruise

RICS Headquarters is the main office building of the RICS, located on Parliament Square in the heart of London. See below for directions.

Address: 12 Great George Street, London, SW1P 3AD

On the evening of the 9th September there will be a river cruise down the Thames, with dinner. Tickets are on a first come first served basis and will be handed out at the conference earlier in the day. The meeting point for the cruise is just north of Westminster Bridge, near the pier. Members of staff from the conference will be waiting to greet you.

11th September: Afternoon Tea, House of Commons Churchill Room, 4pm.

Tickets for the Afternoon Tea are on a first come, first served basis. They will be handed out on the day of the industry conference (10th September).

Entrance to the Churchill Room of the House of Commons is via the Cromwell Green entrance on St Margaret Street. Please bring a form of photo ID with you (e.g. passport).

Getting there

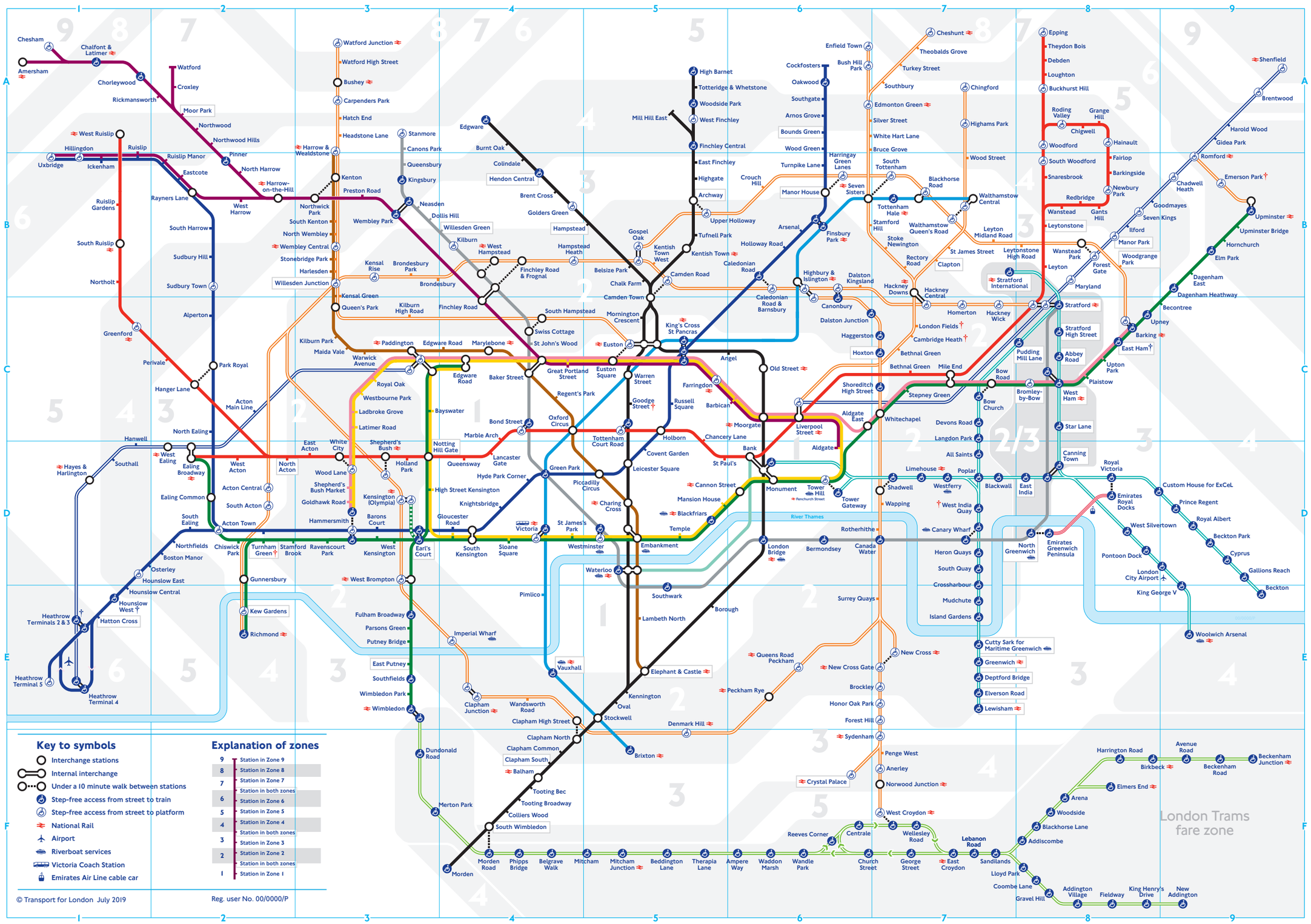
The nearest London Underground Station to RICS HQ and the House of Commons is Westminster, located just east of RICS, along Great George Street (see map above).

Travelling from:

Euston: take the Victoria Line from Euston Underground Station to Victoria, change and take the District or Circle line from Victoria to Westminster (13 minutes).

Kings Cross St Pancras: take the Victoria Line from Kings Cross St Pancras Underground Station to Victoria, change and take the District or Circle line to Westminster (14 minutes).

Tube map



MAYOR OF LONDON

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*Service and network charges may apply. See tfl.gov.uk/terms for details.

UNDERGROUND
TRANSPORT FOR LONDON
EVERY JOURNEY MATTERS

Index to stations

Grid	Station & facilities	Zones
C8	Abbey Road	2/3
D2	Acton Central	3
C2	Acton Main Line	3
D2	Acton Town	3
F8	Addington Village	Special
F8	Addiscombe	Special
D6	Aldgate	1
C6	Aldgate East	1
D7	All Saints	2
C2	Alperton	4
A1	Amersham P	9
F6	Ampere Way	Special
F7	Anerley	4
C6	Angel	1
B5	Archway	2/3
F8	Arena	Special
A6	Arnos Grove P	4
B6	Arsenal	2
F9	Avenue Road	Special
C4	Baker Street	1
F4	Balham	3
D6	Bank † (DLR only)	1
C6	Barbican	1
C8	Barking † (District and Hammersmith & City lines only) (London Overground only)	4
B8	Barkingside P	4
D3	Barons Court	2
C3	Bayswater	1
F9	Beckenham Junction P †	Special
F9	Beckenham Road	Special
E9	Beckton	3
D9	Beckton Park	3
C9	Becontree	5
F5	Beddington Lane	Special
F4	Belgrave Walk	Special
B5	Belsize Park	2
D6	Bermondsey	2
C7	Bethnal Green (Central line)	2
C7	Bethnal Green (London Overground)	2
F8	Birkbeck	Special
D5	Blackfriars	1
F8	Blackhorse Lane	Special
B7	Blackhorse Road (London Overground only)	3
D7	Blackwall	2
C4	Bond Street (Central line only) (Jubilee line only)	1
E5	Borough	1
D2	Boston Manor	4
A6	Bounds Green	3/4
C7	Bow Church	2
C7	Bow Road	2
B4	Brent Cross P	3
A9	Brentwood P	9
F5	Brixton	2
E7	Brockley	2
C8	Bromley-by-Bow	2/3
B3	Brondesbury	2
B3	Brondesbury Park	2
A7	Bruce Grove	3
A8	Buckhurst Hill P	5
A4	Burnt Oak P	4
A6	Bush Hill Park P	5
A3	Bushey P	8
B6	Caledonian Road	2
B6	Caledonian Road & Barnsbury	2
C7	Cambridge Heath †	2
B5	Camden Road	2
C5	Camden Town	2
D7	Canada Water	2
D7	Canary Wharf	2
D8	Canning Town †	2/3
D6	Cannon Street †	1
B6	Canonbury (Trains to Richmond, Clapham Junction & Stratford) (Trains to other destinations)	2
B3	Canons Park P	5
A3	Carpenders Park	7
F6	Centrale	Special
B9	Chadwell Heath	5
A1	Chalfont & Latimer P	8
B5	Chalk Farm	2
C5	Chancery Lane	1
D5	Charing Cross †	1
A1	Chesham P	9
A7	Cheshunt P	8
A8	Chigwell	4
A7	Chingford P	5
D2	Chiswick Park	3
A1	Chorleywood P	7
F6	Church Street	Special
F4	Clapham Common	2
E4	Clapham High Street	2
E4	Clapham Junction †	2
F4	Clapham North	2
F4	Clapham South	2/3
B7	Clapton	2/3
A6	Cockfosters P	5
B4	Colindale P	4
F4	Colliers Wood	3
F8	Coombe Lane	Special
D5	Covent Garden	1
E7	Crossharbour	2
B6	Crouch Hill	3
A2	Croxley P	7
F6	Crystal Palace P	3/4
D9	Custom House for ExCeL	3
E7	Cutty Sark for Maritime Greenwich	2/3
D9	Cyprus	3
B9	Dagenham East	5
B9	Dagenham Heathway	5
C6	Dalston Junction	2
B6	Dalston Kingsland	2
A8	Debden P	6
F5	Denmark Hill	2
E7	Deptford Bridge	2/3
C7	Devons Road	2
B3	Dollis Hill	3
F3	Dundonald Road	Special
D2	Ealing Broadway †	3
D2	Ealing Common	3
D3	Earl's Court	1/2
D3	East Acton	2
F7	East Croydon	Special
B5	East Finchley P	3
C8	East Ham †	3/4
D8	East India	2/3
E3	East Putney	2/3
B2	Eastcote P	5
A4	Edgware	5
C4	Edgware Road (Bakerloo)	1
C4	Edgware Road (Circle/District/H&C)	1
A7	Edmonton Green	4
E5	Elephant & Castle	1/2
F8	Elmers End P †	Special
B9	Elm Park	6
E7	Elverson Road	2/3
D5	Embankment	1
B9	Emerson Park †	6
D8	Emirates Greenwich Peninsula	Special
D8	Emirates Royal Docks	Special
A6	Enfield Town P	5
A8	Epping P	6
C5	Euston † (London Overground only)	1
C5	Euston Square	1
B8	Fairlop P	4
C5	Farringdon	1
F8	Fieldway	Special
A5	Finchley Central P	4
B4	Finchley Road	2
B4	Finchley Road & Frognal	2
B6	Finsbury Park	2
B8	Forest Gate	3
E7	Forest Hill P	3
E3	Fulham Broadway	2
D9	Gallions Reach	3
B8	Gants Hill	4
F7	George Street	Special
A9	Gidea Park P	6
D4	Gloucester Road	1
B4	Golders Green †	3
D3	Goldhawk Road	2
C5	Goodge Street †	1
B8	Goodmayes	4
B5	Gospel Oak	2
A8	Grange Hill	4
F8	Gravel Hill	Special
C4	Great Portland Street	1
D4	Green Park †	1
C1	Greenford P	4
E7	Greenwich	2/3
D2	Gunnersbury	3
C7	Hackney Central P	2
B7	Hackney Downs	2
C7	Hackney Wick	2
C7	Haggerston	2
A8	Hainault P	4
D3	Hammersmith (Circle, District and Hammersmith & City lines only) (Piccadilly line only)	2
B5	Hampstead	2/3
B4	Hampstead Heath	2
C2	Hanger Lane	3
D1	Hanwell	4
B3	Harlesden	3
A9	Harold Wood P	6
B6	Harringay Green Lanes	3
F8	Harrington Road	Special
A3	Harrow & Wealdstone P	5
B2	Harrow-on-the-Hill P	5
A3	Hatch End P	6
E1	Hatton Cross P	5/6
D1	Hayes & Harlington	5
A3	Headstone Lane	5
E1	Heathrow Terminals 2 & 3 †	6
E1	Heathrow Terminal 4	6
E1	Heathrow Terminal 5	6
B4	Hendon Central	3/4
D7	Heron Quays	2
A5	High Barnet P	5
D3	High Street Kensington	1
A7	Highams Park P	4
B6	Highbury & Islington (London Overground only)	2
B5	Highgate P	3
B1	Hillingdon P	6
C5	Holborn	1
D3	Holland Park	2
B6	Holloway Road	2
C7	Homerton	2
E7	Honor Oak Park	3
B9	Hornchurch P	6
E1	Hounslow Central	4
D1	Hounslow East P	4
E1	Hounslow West P †	5
C7	Hoxton	1/2
D4	Hyde Park Corner	1
B1	Ickenham P	6
B8	Ilford	4
E4	Imperial Wharf	2
E7	Island Gardens	2
E5	Kennington	2
C3	Kensal Green	2
B3	Kensal Rise	2
D3	Kensington (Olympia)	2
B5	Kentish Town	2
B5	Kentish Town West	2
B3	Kenton	4
E2	Kew Gardens	3/4
B4	Kilburn	2
C3	Kilburn High Road	2
C3	Kilburn Park	2
E9	King George V	3
F9	King Henry's Drive	Special
C5	King's Cross St Pancras †	1
B3	Kingsbury	4
D4	Knightsbridge	1
C3	Ladbroke Grove	2
E5	Lambeth North	1
D4	Lancaster Gate	1
C7	Langdon Park	2
C3	Latimer Road	2
F7	Lebanon Road	Special
D5	Leicester Square	1
E7	Lewisham †	2/3
B8	Leyton	3
B7	Leyton Midland Road	3
B8	Leytonstone P	3/4
B8	Leytonstone High Road	3
D7	Limehouse	2
C6	Liverpool Street †	1
F8	Lloyd Park	Special
D6	London Bridge †	1
D9	London City Airport	3
C7	London Fields †	2
A8	Loughton P	6
C3	Maida Vale	2
B6	Manor House	2/3
B8	Manor Park	3/4
D5	Mansion House	1
C4	Marble Arch	1
B8	Maryland	3
C4	Marylebone †	1
F3	Merton Park	Special
C7	Mile End	2
A5	Mill Hill East P	4
F5	Mitcham	Special
F5	Mitcham Junction P †	Special
D6	Monument †	1
A2	Moor Park P	6/7
C6	Moorgate	1
F4	Morden P	4
F4	Morden Road	Special
C5	Mornington Crescent	2
E7	Mudchute	2
B3	Neasden	3
F9	New Addington	Special
E7	New Cross †	2
E7	New Cross Gate	2
B8	Newbury Park P	4
D2	North Acton	2/3
C2	North Ealing P	3
D8	North Greenwich P †	2/3
B2	North Harrow	5
B3	North Wembley	4
D2	Northfields	3
B1	Northolt	5
B3	Northwick Park	4
A2	Northwood P	6
A2	Northwood Hills	6
F7	Norwood Junction P	4
D3	Notting Hill Gate	1/2
A6	Oakwood P	5
C6	Old Street †	1
D2	Osterley P	4
E5	Oval	2
C4	Oxford Circus	1
C3	Paddington (Circle and Hammersmith & City lines and TfL Rail only)	1
C2	Park Royal	3
E3	Parsons Green	2
E6	Peckham Rye	2
F7	Penge West P	4
C2	Perivale P	4
F4	Phipps Bridge	Special
D5	Piccadilly Circus †	1
E4	Pimlico	1
B2	Pinner P	5
C8	Plaistow	3
D8	Pontoon Dock	3
D7	Poplar	2
B3	Preston Road	4
D9	Prince Regent	3
C8	Pudding Mill Lane	2/3
E3	Putney Bridge	2
C3	Queen's Park	2
E6	Queens Road Peckham	2
B3	Queensbury P	4
D4	Queensway	1
D3	Ravenscourt Park	2
B2	Rayners Lane P	5
B7	Rectory Road	2
B8	Redbridge P	4
F6	Reeves Corner	Special
C4	Regent's Park	1
E2	Richmond P †	4
A2	Rickmansworth P	7
A8	Roding Valley	4
B9	Romford	6
D7	Rotherhithe	2
D9	Royal Albert	3
C3	Royal Oak	2
D8	Royal Victoria	3
B1	Ruislip P	6
B1	Ruislip Gardens P	5
B2	Ruislip Manor	6
C5	Russell Square	1
B7	St James Street	3
D4	St James's Park	1
C4	St John's Wood	2
D5	St Paul's	1
F7	Sandilands	Special
B8	Seven Kings	4
B6	Seven Sisters (London Overground only)	3
D7	Shadwell (DLR only)	2
A9	Shenfield P	Special
D3	Shepherd's Bush (London Overground only)	2
D3	Shepherd's Bush Market	2
C7	Shoreditch High Street	1
A7	Silver Street	4
D4	Sloane Square	1
B8	Snaresbrook P	4
D2	South Acton	3
D2	South Ealing	3
C4	South Hampstead	2
B2	South Harrow P	5
D4	South Kensington	1
B3	South Kenton	4
D7	South Quay	2
B1	South Ruislip P	5
B7	South Tottenham	3
F4	South Wimbledon	3/4
B8	South Woodford P	4
D1	Southall	4
A7	Southbury	5
E3	Southfields	3
A6	Southgate	4
E5	Southwark	1
D2	Stamford Brook	2
B7	Stamford Hill	3
A3	Stanmore † P	5
C8	Star Lane	2/3
C7	Stepney Green	2
E5	Stockwell	2
B7	Stoke Newington	2
B3	Stonebridge Park	3
C8	Stratford P (Jubilee line and DLR) (Central line, London Overground and TfL Rail)	2/3
C8	Stratford High Street	2/3
B7	Stratford International	2/3
B2	Sudbury Hill	4
B2	Sudbury Town P	4
E7	Surrey Quays	2
C4	Swiss Cottage	2
F7	Sydenham	3
D5	Temple	1
A7	Theobalds Grove P	7
F5	Therapia Lane	Special
A8	Theydon Bois P	6
F4	Tooting Bec	3
F4	Tooting Broadway	3
C5	Tottenham Court Road † (Central line only) (Northern line only)	1
B7	Tottenham Hale P	3
A5	Totteridge & Whetstone P	4
D6	Tower Gateway	1
D6	Tower Hill	1
B5	Tufnell Park	2
A7	Turkey Street	6
D2	Turnham Green †	2/3
B6	Turnpike Lane	3
B9	Upminster P (District line only)	6
B9	Upminster Bridge	6
C8	Upney	4
B5	Upper Holloway	2
C8	Upton Park	3
B1	Uxbridge	6
E4	Vauxhall †	1/2
D4	Victoria † (Circle and District lines only) (Victoria line only)	1
F6	Waddon Marsh	Special
B7	Walthamstow Central P † (London Overground only)	3
B7	Walthamstow Queen's Road	3
F6	Wandle Park	Special
E4	Wandsworth Road	2
B8	Wanstead P	4
B8	Wanstead Park	3
D7	Wapping	2
C5	Warren Street	1
C3	Warwick Avenue	2
D5	Waterloo † (Jubilee line only)	1
A2	Watford P	7
A3	Watford High Street	8
A3	Watford Junction P	Special
F7	Wellesley Road	Special
B3	Wembley Central	4
B3	Wembley Park P	4
D2	West Acton	3
D3	West Brompton (London Overground only)	2
F7	West Croydon (London Overground only) (London Trams only)	5
D2	West Ealing	3
A5	West Finchley	4
C8	West Ham	2/3
B4	West Hampstead (Jubilee line only)	2
B2	West Harrow	5
D7	West India Quay †	2
D3	West Kensington	2
A1	West Ruislip P	6
D8	West Silvertown	3
C3	Westbourne Park	2
D7	Westferry	2
D5	Westminster † (Jubilee line) (Circle and District lines)	1
D3	White City	2
A7	White Hart Lane	3
C7	Whitechapel	2
B4	Willesden Green	2/3
B3	Willesden Junction	2/3
E3	Wimbledon P †	3
E3	Wimbledon Park	3
A6	Wood Green	3
D3	Wood Lane	2
B7	Wood Street	4
A8	Woodford P	4
B8	Woodgrange Park	3/4
F8	Woodside	Special
A5	Woodside Park P	4
E9	Woolwich Arsenal	4

Explanation of symbols

- P — Stations with car parks
- Stations with bicycle parking
- Male/female/baby changing/accessible toilets outside ticket gateline
- Male/female/baby changing/accessible toilets inside ticket gateline
- † Toilet not managed by London Underground. You may be charged for these facilities. Ask staff for information
- Step-free access from street to train
- Step-free access from street to platform
- Stations with London Travel Information Centre
- † Services or access at these stations are subject to variation. To check before you travel, visit tfl.gov.uk/plan-a-journey

Program at a Glance

Sunday, 8th September 2019

13:00 – 14:00	Registration (Foyer) @ The Waldorf Hilton
14:00 – 16:00	Welcome drinks at THE WALDORF HILTON (Aldwych, London, WC2B 4DD, United Kingdom)– Hosted by CIOB Global CEO Caroline Gumble

Monday, 9th September 2019

07:30-08:30	Registration (Foyer) @ RICS Headquarters 12, Great George St, Westminster, London SW1P 3AD (Parliament Square)
08:30-08:40	Opening address by Prof. Syed M. Ahmed, CITC-11 Chair
08:40-08:50	Welcome to Westminster/London with Lord Knight of Weymouth
08:50-09:00	Dr Paul Hampton (Co-Host)
09:00-09:30	Keynote: What does being a professional mean in this day and age?
09:30-10:00	Morning Coffee/Tea Break (Foyer)
10:00 – 12:00	Session 1a: Lecture Hall 1b: Brussels Room
12:00-13:00	Lunch & Networking with Delegates
13:00-13:30	Keynote: Construction Management Education – A Historical Snapshot from both sides of the Atlantic
13:30-14:30	Session 2a: Lecture Hall Session 2b: Brussels Room
15:00-15:30	Afternoon Coffee/Tea Break
15:30- 16:00	Keynote: Digital Construction Future
16:00-17:30	Session 3a: Lecture Hall Session 3b: Brussels Room
19:15- 22:30	Dinner Cruise Meeting Place: Westminster Bridge – Tickets will be issued on Monday at the conference
19:30	Embark on Dinner Cruise
22:30	Disembark

Tuesday, 10th September 2019

08:30-09:00	Keynote: Gender Equality in Built Environment HE: Athena SWAN Prof. Nazira Karodia/ Dr. Subashini Suresh/ Dr. Paul Hampton
09:00-09:30	Keynote: CMAA a Partern for the Future Andrea Rutledge
09:30-10:00	Morning Coffee/Tea Break
10:00-11:30	Session 4a: Lecture Hall Session 4b: Brussels Room
11:30-12:00	Keynote: Digital Technology and Integration in Construction: The UAE Context Irtishad Ahmad
12:00-13:00	Lunch & Networking
13:00-13:30	Keynote: Unstable Links and Untapped Synergies between Academia, Construction Industry, Government & Society at Large Dr. Mohan M. Kumaraswamy
13:30-15:20	Session 5a: Lecture Hall

	Session 5b: Brussels Room
15:20-15:45	Afternoon Coffee/Tea Break
15:45-17:15	Session 6: Lecture Hall Workshop: Managing Risks in Multi-Stakeholders' Projects Dr. Mohamed El Agroudy

Wednesday 11th September 2019 – House of Commons Afternoon Tea/Closing Pleanary

Morning	Delegates free time to discover London/Westminster
15:30 - 15:45	Registration at the House of Commons – Churchill Room – Entrance via Cromwell Green visitors entrance YOU MUST HAVE INVITATION – Which will be issued on Monday/Tuesday of the conference
16:00 – 16:05	Welcome (Dr Paul Hampton – MC for event)
16:05 – 16:10	Welcome to the House of Commons (Palace fo Westminster)– Rt Hon Lord Paul PC (Chancellor of the University of Wolverhampton)
16:10 – 16:25	Keynote: Professor Geoff Layer (Vice-Chancellor of the University of Wolverhampton)
16:25 – 17:40	Afternoon Tea and networking at the House of Commons
17:40 – 17:50	Close of Conference CITC 11 Westminster/London - Prof. Syed M. Ahmed/Dr Paul Hampton Hand-over Conference Trophy
17:50 – 18:00	Depart Churchill Room

CITC 11 Program

Sunday, 8th September 2019

13:00 – 14:00- Registration (Foyer) @ The Waldorf Hilton
14:00 – 16:00 – Welcome drinks at THE WALDORF HILTON (Aldwych, London, WC2B 4DD, United Kingdom)– Hosted by CIOB Global CEO Caroline Gumble

Monday, 9th September 2019

07:30-08:30	**Registration** (Foyer) @ RICS Headquarters 12, Great George St, Westminster, London SW1P 3AD (Parliament Square)		
08:30-08:40	**Opening address by Prof. Syed M. Ahmed**, CITC-11 Chair **Room:** Lecture Hall		
08:40-08:50	**Welcome to Westminster/London** **Lord Knight of Weymouth** **Room:** Lecture Hall		
08:50-09:00	**Dr Paul Hampton (Co-Host)** **Room:** Lecture Hall		
09:00-09:30	**Keynote:** What does being a professional mean in this day and age? **Peter Bolton-King** **Room:** Lecture Hall		
09:30-10:00	**Morning Coffee/Tea Break (Foyer)** **Room:** Council Chamber		
10:00 – 12:00		**Session 1a:** Lecture Hall **Session Chair:** Wesley Collins	**Session 1b:** Brussels Room **Session Chair:** Salwa Beheiry
	10:00	(ID 15) Reducing Our Energy Usage and Reliance to Mechanical Air Conditioning through Passive Cooling: Can It Be Done at Home Today? **Junshan Liu, Scott Kramer**, and Marisol Cho	(ID 18) Exploring the Working Conditions of People in Construction Lesiba Mollo and **Fidelis Emuze**
	10:10	(ID 107) Expectations from the welding curriculum based on the perspective of engineering technology graduates in Nigeria **Eghosa Eguabor** and Clinton Aigbavboa	(ID 14) Antecedents of client loyalty in the construction professional services sector: A qualitative study **Nick Williams**, Ezekiel Chinyio, Paul Hampton, and Nii Ankrah
	10:20	(ID 41) Life cycle costing for decision making in construction and demolition waste management: A review **I M Chethana S Illankoon** and Vivian W Y	(ID 89) Digital asset information management for transport infrastructure: framework and implementation **Peng Wu**, Jun Wang, Ammar Shemery, and Keith Hampson
	10:30	(ID 11) An assessment tool to measure the Lean Construction maturity level	(ID 23) A Factor Analysis of Transportation Infrastructure Feasibility Study Factors: A Study among Built

		Ahmed Helmy Mohamed	Environment Professionals in South Africa **Chioma Okoro**, Innocent Musonda, and Justus Agumba
	10:40	(ID 32) Risk management in procurement of blue-green roofs - supplier perspective **Erlend Andenaes**, Berit Time, Olav Torp, Tore Kvande, and Jardar Lohne	(ID 40) Developing a Sustainable Concrete using Ceramic Waste Powder **Tariq Umar**, Abdullah Tahir, Charles Egbu, Mohamed Shaik Honnurvali, Messaoud Saidani, and Ahmed Jalil Al-Bayati
	10:50	(ID 2) Inventory Management and Construction Project Delivery in Nigeria **Dubem Ikediashi** and Godfrey Udo	(ID 129) Current Status of Awareness and Readiness Towards Building Information Modelling (BIM) Among Sri Lankan Quantity Surveyors **Anushka Rathnayake** and Hamir Samir
	11:00	(ID 126) Multi-objective Resource-Constrained Scheduling in Construction Projects Vasiliki Lazari and **Athanasios Chassiakos**	(ID 43) Innovative vocational training for the Construction Industry **Valerie Francis** and Vidal Paton Cole
	11:10	(ID 81) Characteristics of Bidding for Engineering Services in Public Construction Projects **Khaled Hyari** and Omar Hiary	(ID 26) Investigating the Criticalities of Corruption Forms in Infrastructure Projects in the Developing Context **Emmanuel Kingsford Owusu**, Albert Chan, and David Edwards
	11:20	Q & A and Discussion	Q & A and Discussion
12:00-13:00	**Lunch & Networking with Delegates** **Room:** Council Chamber		
13:00-13:30	**Keynote:** Construction Management Education – A Historical Snapshot from both sides of the Atlantic **Dr. Richard Burt** **Room:** Lecture Hall		
13:30-14:30		**Session 2a:** Lecture Hall **Session Chair:** Valerie Francis	**Session 2b:** Brussels Room **Session Chair:** Tom Leathem
	13:30	(ID 6) Overview of Concrete Durability Evaluation using Electrical Resistivity **Amin Akhnoukh**	(ID 42) Quantitative assessment of resilient safety culture model using relative importance index Arun Garg, Anwar Alroomi, Fahim Tonmoy, and **Sherif Mohamed**
	13:40	(ID 35) Assessment of the Level of Awareness of Robotics and Construction Automation in South African Opeoluwa Akinradewo, Ayodeji Oke, **Clinton Aigbavboa**, and Mashangoane Molau	(ID 91) Challenges Affecting Leadership Development in the Construction Industry Murendeni Liphadzi, Clinton Aigbavboa, Temidayo Onsusanmi, and **Didibkhuku Thwala**
	13:50	(ID 117) Augmented Reality (AR) for utility infrastructure: An experiential development workflow Poorang Piroozfar, **Alex Judd, Simon Boseley**, Amer Essa, and Eric Farr	(ID 56) A Pilot of Student Guided Virtual Reality Tours **Jeffrey Kim**
	14:00	(ID 37) Effectiveness of Contractors' Competitive Bidding	(ID 70) Costing of Health and Safety elements in

		Strategies in the UAE Construction Industry Dima Arouk, and **Sameh El-Sayegh**	Construction Projects in Gauteng, South Africa Jirew Akawi and **Innocent Musonda**
	14:10	(ID 12) Best Management Practices in Design, Construction, and Maintenance of Mechanical Systems in Data Centers Prabha Sharma, **Scott Kramer**, Junshan Liu	(ID 59) Construction Health and Safety (H&S) Practitioners' Developmental Needs **John Smallwood** and Claire Deacon
	14:20	(ID 136) Critical Factors Influencing the Bid/No Bid Decision in Pakistan Construction Industry **Nida Iftikhar**, Jamaluddin Thaheem, Bilal Iftikhar	(ID 128) Investigation of Electronic Document Management applications in the Construction Projects: Case Study in Jordan **Hesham Ahmad**, Turki Al-Suleiman (Obaidat) and Abeer Elhour
	14:30	(ID 27) Benchmarking Project Manager's Compensation **Khalid Siddiqi** and Enes Kol	(ID 29) Are Syllabi Optimizing Teaching and Learning for All? Ben Farrow, April Simons, and **Tom Leathem**
	14:40	Q & A and Discussion	Q & A and Discussion
15:00-15:30	**Afternoon Coffee/Tea Break** **Room:** Council Chamber		
15:30- 16:00	**Keynote:** Digital Construction Future **Prof. Mohammed Arif** **Room:** Lecture Hall		
16:00-17:30		**Session 3a:** Lecture Hall **Session Chair:** Jeffrey Kim	**Session 3b:** Brussels Room **Session Chair:** Salman Azhar
	16:00	(ID 16) Enhancing Innovativeness in the Construction Sector: A System Dynamics Analysis Emiliya Suprun, **Rodney Stewart**, Oz Sahin, and Kriegngsak Panuwatwanich	(ID 49) Construction-Related Waivers to the Small Unmanned Aircraft Systems Rule in the United States **Michele Herrmann**
	16:10	(ID 127) Contingency Use and Project Delivery Influence on Infrastructure Project Risk Assessment **Mohamed Diab** and Mohammed Mehany	(ID 20) Construction and Demolition Waste Management on Construction Sites in Kazakhstan **Abid Nadeem**, Altynay Khamatova, Md Aslam Hossain, and Hau Yan Leung
	16:20	(ID 21) General Contractor Knowledge of Infection Control Requirements on Hospital Renovation Construction Projects **Wesley Collins**, Paul Holley, Abhay Chavan, and Anoop Sattineni	(ID 118) Augmented Reality for Urban Utility Infrastructure: A UK perspective Poorang Piroozfar, **Alex Judd, Simon Boseley**, Amer Essa, and Eric Farr
	16:30	(ID 39) Physical and Mental Health of Construction Workers: A Worse Status? **Yang Yang**, Albert Pin-Chuen Chan, and Joanne Wai-Yee Chung	(ID 22) Building Information Modelling in Transport Infrastructure Secture **Haddy Jallow**, Suresh Renukappa, Subashini Suresh, and Ahmed Alneyadi
	16:40	(ID 47) Owners' Obligations Under FIDIC Construction	(ID 123) Project Control Through Disincentivisation: A

		Contracts **Omar Alhyari**	Case Study of Hong Kong-Zhuhai-Macau Bridge Project **Liuying Zhu**, Sai On Cheung, Xinglin Gao, Qian Li, and Gang Liu
	16:50	(ID 105) Water Conservation and Environmental Sustainability Approach **Irfan Abid**, Haroon Amal Khattak, and Rai Waqas Azfar	(ID 57) Factors Affecting Indoor Environmental Qualities of Social Housing Projects in South Africa **Mpho Ndou**, Clinton Aigbavboa, and Felicia Yaka
	17:00	(ID 25) Identification of Critical Factors for Construction Megaprojects Success (CMS) **Ting Wang**, Albert P.C. Chan, and Qinghua He	(ID 96) Current Sources of Financing Power Infrastructure in Developing Countries: Principal Component Analysis Approach **Emmanuel Oikelomen Ayorinde**, Ntebo Ngcobo, and Kasenge Mathe
	17:10	Q & A and Discussion	Q & A and Discussion
19:15- 22:30	19:15	**Dinner Cruise** Meeting Place: Westminster Bridge – Tickets will be issued on Monday at the conference	
	19:30	Embark on Dinner Cruise	
	22:30	Disembark	

Tuesday, 10th September 2019

08:30-09:00	**Keynote:** Gender Equality in Built Environment HE: Athena SWAN **Prof. Nazira Karodia/ Dr. Subashini Suresh/ Dr. Paul Hampton** **Room:** Lecture Hall		
09:00-09:30	**Keynote:** CMAA a Partern for the Future **Andrea Rutledge**		
09:30-10:00	**Morning Coffee/Tea Break** **Room:** Council Chamber		
10:00-11:30		**Session 4a:** Lecture Hall **Session Chair:** Dr. Subashini Suresh	**Session 4b:** Brussels Room **Session Chair:** Fidelis Emuze
	10 :00	Modern Slavery in Construction **Chris Blythe and Paul Hampton**	Towards a Construction Living Learning Laboratory (CL3): A Vision for Springfield SoABE **David Heeson**
	10:10	CIOB Global Professional Body **Eddie Tuttle and Ros Thorpe**	EnTRESS Waste management project case-study **Anthony Hatfield**
	10:20	How Can Mobile App Technology Further Benefit Project Managers by Improving & Increasing Working Productivity **Klare Lau and Paul Hampton**	Deconstruction of the Broadmarsh Carpark Bus Station, Nottingham City Centre, UK **Richard Dolman and Patricia Sloneczny**
	10:30	Big data and behaviorial Science:Delivering quality in	Architects Perspective - Lakefield Road for WV Living

		construction **Rupert Shingleton**	**Ian Foden**
	10:40	Implementing Quality Control Management on the London Bridge Station Project **Sandra Nicholls and Alan Wong**	Demolition Sector Challenges **Mike Kehoe or C&D Representative**
	10:50	Modern Demolition – Case study **David Atkinson**	Deployment of Building Information Modelling (BIM) for Energy Efficiency in the UK **David Oloke**
	11:00	(ID 61) Practical Application of Natural Pozzolans and Lime for Cost Optimisation in Low Cost Housing **Dans Naturinda**	(ID 93) Enhancing the Visualization of Problems Tracking and Management Integrated BIM Technology for General Contractor in Construction **Yu-Cheng Lin** and Ya-Ting Hsu
	11:10	Q & A and Discussion	Q & A and Discussion
11:30-12:00	**Keynote:** Digital Technology and Integration in Construction: The UAE Context **Irtishad Ahmad**		
12:00-13:00	**Lunch & Networking** **Room:** Council Chamber		
13:00-13:30	**Keynote:** Unstable Links and Untapped Synergies between Academia, Construction Industry, Government & Society at Large **Dr. Mohan M. Kumaraswamy** **Room: Room:** Lecture Hall		
13:30-15:20		**Session 5a:** Lecture Hall **Session Chair:** Dr. Paul Hampton	**Session 5b:** Brussels Room **Session Chair:** Anthony Hatfield
	13:30	The Demolition of Britain's Last Deep Coal Mine – Kellingley Colliery (Industrial Case Study) **Charlene Murray**	(ID 130) Exploring Individual Adaptability as a Prerequisite for Adjusting to Technological Changes in Construction Derek Asante Abankwa, Rita Yi Man Li, Steve Rowlinson, and **Yadi Li**
	13:40	Quantity Surveying **Pauline Corbett and Louise Verney**	Sustainable Development of Wolverhampton Race Course **Anju Rai and Tom Mills**
	13:50	Regenerating Heath Town **Shaun Aldis**	Risks Associated with the Development and Growth of Property SME's **Richard Moxon**
	14:00	BECCI Domestic battery project-case study **Robert Stuart**	Streblo: The App Prototype for Managing Stress in the Construction Industry **Dr. Silvia Riva, Dr. Paul Hampton, and Dr. Ezekiel Chinyio**
	14:10	**Perception of University Students on Gender Issues in the Industry**	Deconstruction and Demolition Supporting Regeneration Through High Speed Rail Connectivity

		Subashini Suresh 1, Amal Hj Abdul Aziz1, Mark Stride 2, Suresh Renukappa1 and Paul Hampton1	**Christina Wallace**
	14:20	How to Avoid and Resolve Disputes During the Construction Process **Keith Blizzard**	Tackling the War for Talent : The Need for Improving Diversity and Inclusion in Real Estate and Construction **Amanda Clack**
	14:30	Khalsa Academy: Refurbishment of the Existing Former Tarmac Headquarters Building into 850 Pupil Secondary School, Ettingshall, Wolverhampton **Greg Lawley**	(ID 95) Road Infrastructure Project Success: Understanding the Role of Stakeholder Management in a Rural Setting Joy Okwuchi Chizitere Oguzie, Cosmas Ifeanyi Nwakanma, **Achimba Chibueze Ogbonna**, Augustine Ikenna Udunwa
	14:40	Environmental issues **Neil Roe**	Slope Stability in Urban Brazil **Mike Fullen,** ATG Guerra, C. Jorge, and A Soares
	14:50	Q & A and Discussion	Q & A and Discussion
15:20-15:45	**Afternoon Coffee/Tea Break** **Room:** Council Chamber		
15:45-17:15	**Session 6:** Lecture Hall **Session Chair:** Mohamed Diab		
	Workshop: Managing Risks in Multi-Stakeholders' Projects **Dr. Mohamed El Agroudy**		

Wednesday 11th September 2019 – House of Commons Afternoon Tea/Closing Pleanary

Morning	**Delegates free time to discover London/Westminster**
15:30 - 15:45	**Registration at the House of Commons – Churchill Room – Entrance via Cromwell Green visitors entrance** YOU MUST HAVE INVITATION **– Which will be issued on Monday/Tuesday of the conference**
16:00 – 16:05	**Welcome (Dr Paul Hampton – MC for event)**
16:05 – 16:10	**Welcome to the House of Commons (Palace fo Westminster)– Rt Hon Lord Paul PC (Chancellor of the University of Wolverhampton)**
16:10 – 16:25	**Keynote: Professor Geoff Layer (Vice-Chancellor of the University of Wolverhampton)**
16:25 – 17:40	**Afternoon Tea and networking at the House of Commons**
17:40 – 17:50	**Close of Conference CITC 11 Westminster/London - Prof. Syed M. Ahmed/Dr Paul Hampton** **Hand-over Conference Trophy**
17:50 – 18:00	**Depart Churchill Room**