Abstracts for the Proceedings of the

9th International Conference
on Construction in the 21st Century

CITC-9

Dubai, United Arab Emirates
March 5th - 7th, 2017

"Revolutionizing the Architecture, Engineering and Construction Industry through Leadership, Collaboration and Technology"

Editors:
Syed M. Ahmed, Salman Azhar, Norma A. Smith, Shaunna C. Campbell, Laura Russell, Attaullah Shah

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Editors

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Foreword

While technology and innovation are shrinking the distance between countries and industries, leadership and collaboration are actively shaping the construction industry and guiding it to success. Construction in the 21st Century (CITC) is an organization backed by East Carolina University in collaboration with Auburn University, Florida International University, City University of Science and Technology, and King Faisal University. CITC executes international conferences to bring together like-minded construction management professionals. The CITC-9 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-9 is a peer-reviewed conference that acts as a dynamic conduit for the exchange of knowledge. New methods and techniques must be carefully scrutinized and rigorously tested before implementation, and CITC-9 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 hinge on international teamwork and alliance.

This March marks the ninth 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, and CITC-8 in Thessaloniki, Greece of 2015. 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 Ninth International Conference on Construction in the 21st Century: Revolutionizing the Architecture, Engineering and Construction Industry through Leadership, Collaboration and Technology (CITC-9, Dubai). This two and a half day conference is being held in Dubai at Hilton Dubai Jumeirah Resort. CITC-9 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 intend to hold the CITC series of conferences at regular intervals. We gratefully appreciate your attendance, and hope that you will support the future endeavors of CITC.

Thank you and kind regards,

The Editors

Syed M. Ahmed, Chair	Salman Azhar
Norma A. Smith	Shaunna Campbell
Laura Russell	Attaullah Shah

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The USB drive in your conference package contains full versions of all papers in PDF format. The papers can be viewed using Adobe Acrobat Reader.

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March 2017
Greenville, North Carolina, USA

CITC-9 Themes

- Leadership/Management Techniques
- Successful Business Practices
- Architectural Management
- Modern & Future Trends in the Industry
- Building Information Modeling
- Automation and Robotics
- Business Process Engineering
- Bidding and Estimating
- Lean Construction Practices
- Laser Scanning
- 3D Printing
- Augmented and/or mixed reality
- Legal issues in Construction
- Life Cycle Cost and Cost Analysis
- Value engineering
- Procurement Management
- Project and Program Management
- Quality and Productivity Improvement
- Risk Analysis & Management
- Seismic Design Issues
- Successful Business Practices in Construction
- Sustainable Design and Construction
- Concrete Technology
- Construction Contracts
- Construction Economics
- Construction Equipment Management
- Construction Innovation
- Construction Process Simulation
- Construction Projects Administration
- Construction Safety
- Construction Scheduling
- Cost analysis & Cost Control
- Cultural Issues in Construction
- Delays Analysis & Management
- Design & Construction of Tall Buildings
- Design-Build Construction
- Digital Practices in Construction
- Engineering & Construction Materials
- Ethical Issues in Engineering and Construction
- Information Technology and Systems
- Infrastructure Systems and Management
- International Construction Issues
- Leadership in Engineering & Construction

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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-9:

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Contents

Keynote Speaker

Amr Elnashai is the Dean of Engineering at the Pennsylvania State University, and the Harold and Inge Marcus Endowed Chair of Engineering. He created, with the associate/assistant deans and directors, a five-year hiring plan for faculty, staff and development of infrastructure, a strategy for inclusion, created a Communications office and two offices of Associate Dean for Research and Associate Dean for Innovation. Amr previously held positions as the head of the Department of Civil and Environmental Engineering at the University of Illinois at Urbana-Champaign, Director of the NSF multi-institution interdisciplinary Engineering Research Center (ERC) and Director of the NSF Network for Earthquake Engineering Simulations (NEES) Laboratory at Illinois. He is founder and editor-in-chief of the Journal of Earthquake Engineering (Taylor and Francis, SCI-expanded) and editorial board member of several other journals, a member of the drafting panel of the European design codes, UK delegate to and past senior Vice-President of the European Association of Earthquake Engineering and a member of the Council of the UK Institution of Structural Engineers. He serves the ISE as 'US Education Ambassador'. Amr obtained his B.S. degree from Cairo University, followed by MSc and PhD degrees from Imperial College and University of London. He is the winner of the Imperial College Unwin Prize for the best PhD thesis in Civil and Mechanical Engineering, the Oscar Faber Medal for best paper in the Institution of Structural Engineers, and two best paper medals from the International Association of Tall Buildings, Los Angeles. He has produced more than 250 research publications, comprising 146 refereed journal papers and many conference papers, keynote and prestige lectures, three books and several chapters, magazine articles and earthquake investigation reports.

Presenting on Monday March 6th at 09:30

"Research Advances in Optimized Temporary Housing Following Disasters"

Co-Authors:
Omar El-Anwar Associate Professor, Cairo University, Cairo, Egypt
Khaled El-Rayes, Professor, University of Illinois at Urbana-Champaign, Urbana, IL, USA

Abstract
Recent years have witnessed large-scale population displacements following natural disasters, which necessitated the provision of adequate temporary housing solutions. These solutions needed to cater to the socioeconomic and psychological needs of displaced families, have minimal negative environmental impact, and be within available recovery budgets. During the last decade, there has been an intense research effort to develop models capable of optimizing temporary housing configurations in order to address this multifaceted problem. This paper examines the differences and similarities among these optimization models in terms of their objectives, integration of subsequent housing phases, approach to decision-making, optimization tools, and integration with impact assessment software systems

Keynote Speaker

Albert P.C. Chan is a Chartered Construction Manager, Engineer, Project Manager, and Surveyor by profession, Ir Prof. Chan has worked in a number of tertiary institutions both in Hong Kong and overseas. Ir Prof. Chan was also a Founding Director of Construction Industry Institute, Hong Kong, which was a joint research institution developed by industry and the academia. He was a Senior Lecturer and Deputy Head of the School of Building and Planning at the University of South Australia. Since 1996, Ir Prof. Chan has held many positions at the Department of Building and Real Estate of the Hong Kong Polytechnic University such as Associate Head (Teaching), Associate Dean and Interim Dean of the Faculty of Construction and Environment. He is currently Head of Department of Building and Real Estate.
Ir Prof. Chan's research and teaching interests include project management and project success, construction procurement and relational contracting, construction management, economics, health and safety, and industry development. Ir Prof. Chan's research has had a real and significant impact on the construction industry resulting in changes in policy decisions. His recommendations have been incorporated in the Construction Industry Council Guidelines on "Site Safety Measures for Working in Hot Weather" in April 2013. He has produced over 700 research outputs in refereed journal papers, international refereed conference papers, consultancy reports, and has won a number of prestigious research paper and innovation awards. Ir Prof. Chan holds an MSc in Construction Management and Economics from the University of Aston in Birmingham, and a PhD in Project Management from the University of South Australia.

Presenting on Tuesday, March 7th at 08:30

"*SMART Clothing System to Reduce the Risk of Heat Stress in Hot and Humid Weather*"

Abstract
Construction workers in Hong Kong have to work outdoor for long hours under hot and humid weather conditions. To alleviate their discomfort and risk of heat stroke, the research team led by Prof Albert Chan from the Hong Kong Polytechnic University (PolyU) developed an anti-heat stress construction uniform that meets and the challenge of rising temperatures and specific industry requirements. The newly designed uniform provides better ultraviolet protection, and allows for better breathability and a faster evaporation rate of sweat. Taking into consideration that the technology concerned would benefit construction workers via non-profit making promotion by the Construction Industry Council (CIC), PolyU licensed the technology to the CIC for a nominal value of HK$1 as a service to the community. This event is a milestone in releasing this innovation to the public and industries. The CIC fabricated 20,000 sets of the uniforms for their trainees in September 2015. The CIC officially launched the AHSC as the second generation of the uniform for construction workers in September 2016. Relevant contract clauses will be introduced in future government projects to encourage the use of the uniforms. The award-winning uniform can help over 300,000 construction workers in Hong Kong to beat the heat and humidity during the hot summer months.

Keynote Speaker

Dr. Abdul Samad (Sami) Kazi is a Senior Principal Scientist, Smart Energy and Transport Solutions at VTT Technical Research Centre of Finland, a globally networked multi-technological applied research organization. Sami has served in several roles at VTT - Vice President for Research Strategy and Foresight, Research Coordinator, Research Team Leader, Project Manager, etc.

Dr. Kazi has been an active initiator and manager of more than 30 large-scale international research projects spanning different industrial sectors and innovation lifecycle phases. His main research and publication areas have been: knowledge management, systemic innovation, service innovation, ICT for construction projects and processes, and open building manufacturing. Sami is listed in the Marquis Who's Who in Science and Engineering, 7th edition onwards, in the Marquis Who's Who in World, 10th edition onwards, and in the Marquis Who's Who of Emerging Leaders (1st edition). Sami is a recipient of the prestigious FIATECH 2012 STAR Award. He is fellow of the Entovation E100 Global Knowledge Leadership network. He serves as a Distinguished Adjunct Professor at the Asian Institute of Technology and as a Docent at the Hanken School of Economics

Presenting on Monday, March 6th at 19:00

"Intelligent Urban Ecosystems - Putting Smart Cities into the Right Context"

Abstract

The term "Smart Cities" has gained significant prominence over the last decade in particular. It is challenging at times to claim that a new technology or phenomenon is not part of a smart city ecosystem. Questions are often raised as to whether intelligence stems from technology or if its generated by the use of technology by smart people. This keynote makes an attempt to put smart cities into the right context - through an exploration of how smart cities are perceived from both business and scientific perspectives. It is advocated that innovations related to smart cities must strike a balance between desirability (user perspective), viability (economic perspective), and feasibility (environmental perspective). An innovation landscape showcasing different innovations is shown followed by several impact driven challenges and structured roadmaps on what needs to be done in the short, medium, and long term (time to impact at an industrial scale).

Workshop:

"Project Risk Management in Different Stakeholders' Perspectives"

Sunday, 5 March 2017 - 15:00

Hosted by Mohamed El Agroudy

Mohamed El Agroudy has decades of experience in construction engineering and management, a Project Management Professional (PMP), a Risk Management Professional (RMP), and an International Arbitrator. El Agroudy has his BSc in civil/construction engineering, a Masters in contracts and a PhD in risk management. He is teaching Contract/Risk Management at the American University in Cairo. He is also the Chairman of one of the leading Facility Management companies in the Middle East. With both his academic and construction industry background, he has practically trained thousands of professionals around the globe and has performed numerous workshops and keynote speeches in many countries.

(Paper, ID 4)

Impact of Weather Conditions on Construction Labor Productivity in Qatar

Ahmed Senouci
Associate Professor, University of Houston, Houston, TX, USA

Mohammed Al-Abbasi
Maintenance Engineer, Qatar Supreme Education Council, Doha, Qatar

Neil Eldin
Professor, University of Houston, Houston, TX, USA

Abstract
The construction projects in Qatar frequently encounter significant delays. One of the major sources of these delays is Qatar's extreme weather conditions. Hence, the paper studies the impact of weather components of temperature, humidity, and wind on labor productivity in Qatar for four construction trades, namely, formwork, masonry, plaster, and ceramic tiles. These trades were chosen because they are time consuming and commonly found in all types of construction. The weather data and trade labor productivities were recorded for a period of 8 months between July 2013 and February 2014. The results showed that the weather had a high impact on trade labor productivities. The labor productivity in the summer could be as low as half of that in the winter. Linear regression models were developed to predict trade productivities for given weather conditions.

Keywords
Extreme weather, weather impact, labor productivity, linear regression, construction delays

(Paper, ID 7)

Improving Productivity of Road Surfacing Operations with the Help of Lean and Discrete Event Simulation techniques; A UK case study.

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Abstract
Road surfacing is an important module in Highways Development and Maintenance sector. The resurfacing and rehabilitation of road pavements has become a costly requirement due to large number of private and commercial vehicles using the roads that cause pavements to disintegrate rapidly. The roadworks incur not only direct work costs, but also indirect costs from factors such as congestion, motor accidents, traffic disturbance and pollution. Maintenance activities on the roads usually cause delays and queuing. There is obviously a need for quick and cost effective maintenance that minimizes the occurrences and duration of these disruptions. This research investigates the role of Discrete Event Simulation (DES) to enhance the productivity of the delivery of road surfacing operations through achieving higher production rates and minimum road closure times.

Keywords
Paving, Process Improvement, Productivity, Resurfacing, Discrete Event Simulation

(Paper, ID 8)

Research Advances in Optimized Temporary Housing following Disasters

Omar El-Anwar
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Professor, University of Illinois at Urbana-Champaign, Urbana, IL, USA

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Abstract
Recent years have witnessed large-scale population displacements following natural disasters, which necessitated the provision of adequate temporary housing solutions. These solutions needed to cater to the socioeconomic and psychological needs of displaced families, have minimal negative environmental impact, and be within available recovery budgets. During the last decade, there has been an intense research effort to develop models capable of optimizing temporary housing configurations in order to address this multifaceted problem. This paper examines the differences and similarities among these optimization models in terms of their objectives, integration of subsequent housing phases, approach to decision-making, optimization tools, and integration with impact assessment software systems.

Keywords
Temporary Housing, Optimization, Natural Disasters, Decision-Making

(Paper, ID 9)

Building Information Modeling (BIM) Technology Adoption and Implementation in the Sri Lankan Construction Industry - The Diagnosis

David Dylan John
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Marcel Maghiar, Ph.D.
Assistant Professor, Georgia Southern University, Statesboro, Georgia, USA

Abstract
The first of a two-part study to assess the adoption and implementation levels of Building Information Modeling (BIM) in the Sri Lankan Construction industry was designed using both quantitative and qualitative inquiries. The research conducted was an assessment of the existing conditions which is referred to as the diagnosis phase of the project to be used as a foundation for further study and exploration in the second phase; the prescription phase. The focus on the diagnosis phase was to better understand the industry environment for implementing technologies that takes into account the opinions and expertise of the different construction professional disciplines, including Design, Engineering and Project Management disciplines and also examines the perceived challenges to the adoption of BIM as shared by these professionals through an online survey and multiple personal interviews. Existing conditions of the construction industry in Sri Lanka were also studied in attempting to understand the background of perceived challenges and they were considered in the proposed preliminary strategies recommended in this paper for further exploration in the second phase of this study.

Keywords
BIM, Sri Lanka, adoption, construction industry, survey, interviews

(Paper, ID 11)

Factors Affecting Quality of Construction Projects in Swaziland

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Abstract
Quality of projects is one of the traditional and global measures of project performance. For construction projects, the goal and desire of clients, contractors and consultants is to ensure that projects are delivered according to acceptable and agreed standards. In this study, various factors affecting performance quality of construction projects were examined with a view to suggesting improvement measures. Using various variables from relevant literature as the basis, data were obtained through the use of questionnaire administered on contractors, architects, engineers, quantity surveyors as well as project and construction managers. It was discovered that major factors affecting performance quality of construction projects in the study area are related to the use of unskilled and incompetent trade contractors. More so, there is poor on-site supervision and lack of commitment by supervising team shouldered with the responsibilities of ensuring compliance to approved standard. Other issues are related to poor planning and scheduling as well as inadequate knowledge, training and skills of construction workmen. To minimize the impact of these factors and improve performance quality of construction projects, proper and modern construction equipment, techniques and methods should be adopted by construction firms, there should be proper site management and supervision to ensure conformance with drawings and specification and adequate project duration should be allocated and stated in the contract documents.

Keywords
Construction Project, Performance Improvement, Project Performance, Project Quality.

(Paper, ID 12)

Challenges Facing Mentees and Mentors in the South African Construction Industry: A Case of Gauteng Region

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Abstract
A major requirement in the development and growth of an industry or organization is the breeding of new workforce through proper training and effective mentoring by experienced members. However, the process is not expected to be smooth due to

individual dispositions and attitudes, organization interest, avenue and opportunity for mentoring, amongst others. In this study, various challenges of mentoring encountered by mentees and mentors in their mentoring activities were examined. This is with a view to promote effective mentoring among professionals in the construction industry in the quest to improve their productivity and thereby enhance better performance of construction projects. Data were collected through administration of questionnaires on professionals in the built environment using convenient sampling technique. Personality issues that are concerned with differences in behaviors and disposition to matters are the major challenges of mentoring in the construction industry. More so, attitudes of the mentees dictate and affect behaviors of mentors and vice-versa. In view of this, professionals involved in mentoring should be concerned about their attitudes to each other and personal beliefs should not be a basis for judgment. Mutual respect and concern for growth and development should form the basis of mentoring relationships.

Keywords
Knowledge, Mentee, Mentor, Skill, Training.

(Paper, ID 13)

The Viability of the FLIR OneTM Camera for the Corps Of Engineers and Construction Companies

Keith A. Rahn
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Abstract
This paper explores the viability of the FLIR OneTM camera for use by the U.S. Army Corps of Engineers (USACE) on project sites both in the Continental United States (CONUS) and overseas (OCONUS) and viability of its application for construction worldwide. Objectives were to validate or refute usability and benefits of small pocket-sized, cell phone enabled, thermal imaging cameras in these markets. Overall attitude and perception were balanced against expected expense and ease of use utilizing web based surveys and interviews. Target audiences were drawn from USACE personnel, both large and small construction businesses from both national and local companies. Results of the interviews and surveys provided conclusive evidence that there was a lack of general understanding of the benefits and utility of the application of thermal imaging in construction among a majority of the respondents. Based on this, the recommendation for implementation of use of the selected thermal camera was presented in a three phased approach comprised of familiarization and education, limited fielding in conjunction with a typical user profile, followed by a period of cost-benefit analysis. Benefits of incorporating the new model FLIR OneTM into normal business processes with a very minimal upfront investment are provided.

Keywords
Cameras, Construction, FLIR OneTM, Thermal images, Usability

(Paper, ID 14)

Sustainable Technology and Product Innovation in the Built Environment: Bio mimicry Potentials

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Abstract
Sustainable technologies and products balance the triad of economic, social and environmental aspects of sustainability in their creation. The unavailability of which has retarded the growth of the built environment via-a-vis sustainability. For over 3.8 billion years, nature has been in development with time-tested patterns and strategies. This has given birth to bio mimicry, an applied science that offers solutions to human challenges through the study and emulation of nature's forms, processes, and systems. With the global quest for sustainability, the role of nature has become more convoluted, becoming a supreme role model of efficiency, effectiveness, and collaboration. This has however portrayed the potential of bio mimicry as an effective concept and practical tool in the innovation of novel products and technologies with sustainable attributes. This paper reviews the current knowledge on the potential of bio mimicry in the development of products and technologies for the built environment. The findings indicate that stakeholders in the built environment have little or no knowledge of materials birthed from bio mimicry. A definite knowledge of bio mimicry approach is also lacking thereby preventing its successful application. The study, therefore, explores bio mimicry and its potential in heralding an era of novel innovations for the sustainability of the built environment.

Keywords
Bio mimicry, innovation, nature, sustainability, built environment, sustainable technologies and products.

(Paper, ID 15)

An Analytical Approach of the Greek Economic Recession on Construction Industry; its Consequences and Future Perspectives of the Sector

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Abstract
This research aims to unfold the Greek recession's causes and consequences for the construction sector and the future perspectives of the sector. Based on literature review and relevant industry input, 31 attributes associated with construction industry and recessions were identified for further investigation. A questionnaire survey with the participation of 80 engineers was conducted and the Exploratory Factor Analysis was used for the quantitative analysis of the responses. According to the analysis, the prevailing consequence of the economic recession is the high rate of unemployment among the engineers while the three most important causes are the instability of the tax system, the bureaucratic procedures in the administrative institutions and the low investments in the sector. Regarding the future prospects of the Greek construction companies, the findings demonstrate that these depend on the involvement in co- financed projects and their strategic orientation and involvement in foreign markets that are still developing in the area of infrastructure.

Keywords
Construction industry, economic recession

(Paper, ID 16)

Contractors' Access to Funding for Infrastructure Projects in Nigeria: Overcoming the Present Challenge.

Ogunsanya, Oluwabukunmi Ayopo, Aigbavboa, Clinton Ohis & Thwala, Didibhuku Wellington University of Johannesburg, Johannesburg, South Africa

Abstract
In certain countries, specialized banks are established to fund infrastructure development. These banks provide financing to facilitate the delivery of projects, which usually are beyond the financial capability of contracting organizations. Literature confirms that for real development in certain critical sectors of a nation's economy to occur, the support from government and institutional investors are essential. Hence, the need to evaluate contracting firms' access to capital funds to executed construction contracts. The methodology adopted is an exploratory qualitative research approach. The study entails interview of 32 contracting organizations top management staff and a director from one the foremost pension fund administrators in Nigeria. The findings show that there are few of such specialized banks or funding organizations for infrastructure delivery in the country. The Central Bank of Nigeria in 2010 provided financing line of N300Billion for Power and Aviation projects alone. While commercial banks are willing to assist with short-term loans, the interest rates and service charges make the contract unprofitable on the long run. This is because most public construction projects are rarely delivered to time. This situation makes the commercial bank loan less desirable. Also, findings show that there are some Development Finance Institutions in the country, but these are hardly able to provide the mega funds required for major infrastructure projects such as roads, dams and rail construction. These have left the operating space for infrastructure delivery to multinational construction firms and highly capitalized local construction companies. Alternative funding sources were proposed for contractors that will be inclusive. That which will be a composite arrangement of capital funds from internal financial institutions, external financial institutions, institutional investors and donor agencies.

Keywords
Infrastructure, Funding, Loan, Contractors, Project Delivery.

(Paper, ID 17)

Cost of Accidents in Construction in Oman

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Abstract
In this article, the ongoing and planned projects for financial year 2015-2016 in different sectors in Oman are presented. While specific focus is on the construction industry, the costs of accidents associated with projects in different sectors are estimated by two criteria, considering the number of workers and projects values. These costs of accidents are although the accumulating huge amount, however construction organizations and the government can play their role in reducing the cost of accidents. Construction organizations need to improve their safety performance and government can establish safety and health regulatory organizations for conducting inspections and enforcement of safety and health law. Such organizations will not only improve the safety and health performance in construction and other sectors, but will also be a source of revenue and a support to the country's economy. Although there are no construction specific OSH regulations, the review of current OSH regulations, which applies to all industries is given is this article. The availability of construction specific OSH regulations and enforcement will be key to reduce the costs associated with accidents in construction.

Keywords
Health & safety, Management, Safety & hazards, OSH regulations

(Paper, ID 19)

A Review of Construction Industry Expectations of the 21st Century Graduates

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Abstract
The construction industry today and its employers are gradually coming to terms with the fact that its activities require fully equipped construction graduates furnished with the right skills to succeed. However, with the ever-changing needs and challenges of the industry, these skills appear to be in limited supply. The process of identifying the various expectations of the industry for construction graduates is a pivotal step in the development of university curricula, which in turn is key to meeting the needs of the profession. This paper studies the construction industry expectations that are key for construction graduates training. Also, the study presents some recommendations for shaping university curricula to align with the professional perspective. A review of relevant literatures was conducted from journal and conference articles from databases including Taylor and Francis online, Springer, Emerald, ASCE, amongst others. This study found that construction graduates without the required industry skills are not only disadvantaged to themselves but also to the 21st century construction industry. As such, it is key for construction students to develop skills and experiences that fits the future expectations of the industry. It is recommended that Higher Education Institution (HEI) provide increased industry awareness among construction students as well as an overview of its operations as this is key in improving the construction industry in this 21st century and beyond.

Keywords
Construction education, employability, higher education institutions, construction industry, key skills

(Paper, ID 20)

Integrated BIM-analysis Framework for Plan-irregular Structures

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Abstract
Plan-irregular structures are generally more vulnerable to earthquake damage due to torsional response, and they usually need more iterative assessments and adjustments in their structural design. However, in the traditional design process, consistency between design and analysis is not always assured; rather, manual efforts are required to keep them continually in sync. This makes it difficult to achieve a reliable and efficient design especially for plan-irregular structures. To overcome this challenge, this study proposes an integrated framework, where a seamless interaction can be guaranteed between the structural design and analysis processes. Under this framework, Revit Structure Building Information Modeling (BIM) software is connected to the advanced structural analysis software ZEUS-NL through the robust link interface that can transfer data from the design software into the structural analysis software and vice versa. The feasibility of the proposed framework is demonstrated via a pilot implementation.

Keywords
Building Information Modeling (BIM), Plan-irregular structures, integrated framework, Inelastic seismic response

(Paper, ID 23)

A Qualitative Approach to Success Factors of Healthcare Construction Projects in Iran

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Abstract
The healthcare system, as one of the main subsystems of Iran, because of its complexity and technical matters is prone to excessive change while being in need of comprehensive management due to the expenses of medical treatment and more particularly building and maintaining medical centers. Since providing fairness and public satisfaction face the social services system with various responsibilities, success in medical treatment projects becomes a priority, and in other words, a chief goal for strategists and top managers of Iran's healthcare system. It goes without saying that other than managing financial expenses as a success factor, time and quality also have to be taken into consideration. Because of the fact that no inclusive study has been done over this matter in Iran, this study aims to

identify the success factors in such projects. This goal has been achieved by selecting experts in the field of healthcare project construction with at least 15 years of experience through snowball sampling and interviewing them. The gathered data has then been analyzed through content analysis. The results show factors such as communication, sustainability, mental and emotional factors, environmental impacts, and interior design are involved in the success of medical treatment projects. The results of this study can be very useful in increasing the attainment of healthcare facility construction and can help preserve national resources.

Keywords
Healthcare facility construction, Healthcare system, Iran, Success factors.

(Paper, ID 24)

Opportunities and Challenges of Women's Roles in Management positions in the Iranian Construction Industry

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Abstract
In today's world, where countries use their full capacity to be in competition with each other in terms of growth and development, holding human resources as an asset is exceptionally important. Women are a valuable resource for developing countries, which are active in the fields of production and services. However, the role of women has not been significant in construction, which is historically a male dominated industry. Although, in the recent years several studies show the growing presence of women in construction industry in various countries, it seems the flow of women's promotional status towards high-ranking management positions is not parallel to their improvement in education and their ability at work. It appears that invisible barriers obstruct the preferment of women to higher ranks of management. The expression 'glass ceiling' or leakages in the pipelines explains this phenomenon at its best. So that, the higher we go up in organizational levels, fewer women will be present in these areas. In reality, the presence of women in construction industry, due to the existence of those barriers, is limited to consulting, designing, estimation, and office works. These obstructions vary in different societies, cultures, and organizations. Iran, as a country with the majority of Muslim population, has had a very conservative view towards hiring women, especially in construction industry. However, in recent years there has been an impressive growth in the number of female graduates in fields related to construction industry. Thus, the system should develop appropriate infrastructure to exit this situation and exploit the capabilities of specialized women in decision-making levels of the construction industry. Thus, several interviews are conducted, with experts and reporters who are active in management positions, both male and female. Then we analyzed collected data using qualitative content analysis method. After examining the barriers in individual and family, social, and cultural areas, we categorized organizational factors and workplace damages. Among these factors, cultural factors including gender inequality, masculism, and social believe and individual factors including family and personality-related factors, had greater importance regarding the unsuitability of construction industry for women.

Keywords
Glass Ceiling, High-level Management, promotion of women in construction industry, women, women's Participation

(Paper, ID 26)

The Application of Augmented Reality and Virtual Reality in the Construction Industry Using Wearable Devices

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Abstract
Augmented Reality (AR) and Virtual Reality (VR) have been implemented in many industries including the Architecture, Engineering and Construction (AEC) industry. Confusion between AR and VR exists, despite several researchers seeking to clarify the differences. As context-specifics have significant influence on the AEC industry, testing AR/VR applications is not as streamlined as in some other industries. This paper introduces a research project carried out on application of AR/VR in the construction industry whilst attempting to clarify the differences between the two. It starts with an introduction and the justification before a critical literature review sets the scene for discussion of methodology, details of the experiment designed

using advanced AR and VR technologies, which forms the basis of a questionnaire. Results are provided with an in-depth analysis before a discussion, which leads to conclusion. The authors suggest future research takes one of three possible routes; i) to develop an AR or VR system with more specific applications based on the findings of this research; ii) to develop this research to test the hypothesis that AR and VR technologies are optimal when used combined on a project or iii) to progress this research building upon more recent advances in AR technologies.

Keywords
Augmented reality, Construction industry, Head-mounted device, Virtual reality, Wearable devices.

(Paper, ID 27)

Review of Sustainable Design Principles for Leed Certified Buildings: The Case of Turkey

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Abstract
The negative impacts caused by inefficient use of natural resources around the world, global warming and climate change have become a global threat, thereby considerably amplifying in recent years the importance of the concept of 'sustainable development', which led to the emergence of the concept of green buildings in the construction sector. Being green in the construction sector means designing and constructing buildings in such a way as to reduce the negative impact of the building and its users on the environment, climate and human health throughout the building's lifetime. Following the early examples of green building projects, Green Building Certification Systems were created with the aim of certifying, promoting and mainstreaming the environmentally friendly properties of such buildings. Seven LEED certified buildings were selected for the sample and were evaluated with respect to the sustainable design principles. Analyses conducted on the sample, it was concluded that sustainable design principles must be taken into consideration as a whole in designing green buildings. It has become important for architects to be knowledgeable about sustainable design principles to design projects.

Keywords
Sustainability, LEED, Sustainable Design, Green Building, Green Building Certification Systems.

(Paper, ID 28)

Applications for Unmanned Aerial Vehicles in Electric Utility Construction

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Abstract
This paper is based on the results of a research project involving electrical utility contractors and electric utility companies. Utility contractors are currently considering how Unmanned Aerial Vehicles (UAVs), can be leveraged for utility line inspection work. They see an opportunity to expand business by offering UAV inspection services at significantly lower costs than traditional manned helicopter inspection. Utility companies have a large amount of assets, many of which currently require significant costs to monitor via manned helicopters. Currently, the United States (US) Federal Aviation Administration's (FAA) Special Airworthiness Certificate for small UAVs allows utilities to research, test, and train flight crews. Initial aircraft cost can be less than a few thousand USD total, including ground controllers with controls similar to a Sony PlayStation®. These UAVs can be configured with compact cameras and sensors for location, compass direction, and elevation. Additional capabilities include heavier payloads, LIDAR sensors, 15 megapixel cameras, and high definition multispectral cameras. The landscape of quickly improving hardware and solidifying FAA regulations brings about a critical opportunity to leverage UAVs for Transmission, Distribution, and Substation (TD&S) monitoring, along with requisite qualifications, safety, and training.

Keywords
Unmanned Aerial Vehicle, Unmanned Aerial System, Federal Aviation Administration

(Paper, ID 29)

Infrastructure Development in Africa: Eradicating Stumbling Blocks to Maximizing Investment Potentials

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Abstract
Infrastructure encompasses a wide range of inputs, industries and structural elements (including water, roads, sanitation, energy, telecommunication, schools and health services) that facilitate the flow of goods and services and as such, are an indispensable mainstay in many economies. Despite the undeniable function of infrastructure, its development and investment in Africa has been stagnant for decades. The reasons for this disquieting situation have been contemplated and solutions have been advocated or proffered in many studies. However, the problem persists. The current paper reports on findings from a panel discussion at an international conference on infrastructure development and investment held in 2014 in Livingstone, Zambia. The panel members comprised six experts, made up of consultants, developers and contractors, drawn from government departments in Zambia and South Africa. Further interrogative questions were raised by an audience of more than seventy readers of infrastructure in Africa. Findings revealed that poor planning and implementation, poor project packaging, non-compliance to H&S regulations and design specifications, and ineffective procurement strategies hinder realization of maximum benefits from infrastructure investments in Africa. The study also revealed that integrative training of built environment professionals as well as continental and regional integration would maximize infrastructural investment in Africa. The study provides evidence that could be useful to investors, developers and governments across Africa. The findings could aid in redirecting resources (human, intellectual and material) to improve the status quo regarding productivity, capacity and returns from foreign infrastructure investment and developments in Africa.

Keywords
Africa, development, foreign investments, infrastructure

(Paper, ID 31)

Financial Analysis of Greek Construction Enterprises Based on Investment Ratios

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Abstract
The current paper examines the progress of investment ratios of the four most significant Greek construction companies from 2008 to 2012 in order to draw conclusions on the performance and progress of the companies and the reliability of their shares under the generalized economic crisis, which, during the study period, creates unfavorable conditions for the whole industry. To this end, the relationship of figures drawn from the financial statements of these companies was analyzed by calculating ratios. The aim of this study is also the comparison of the progress of the four companies in order to examine the rank of each company in relation to the other selected companies and the assessment of the economic situation of the industry through the progress of the companies. The data is drawn from the annual and periodic financial reports of companies, and more specifically from the balance sheet and income statement as provided in the Athens Stock Exchange website. The provided results verify the situation of the industry in the questioned period. The analyzed companies presented a downward trend throughout the years 2008-2012.

Keywords
Financial Analysis, Greek construction companies, Investment ratios, Financial crisis

(Paper, ID 32)

Analysis of Greek Construction Design - Engineers' Cognitive Abilities, Personality and Knowledge

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Abstract
The role of a project Designer – Engineer is of special importance to the well being, economic prosperity and viability of construction enterprises. This research is aiming at identifying the Greek project Engineers' - Designers' cognitive abilities, personality characteristics, skills and knowledge. An effort is made to identify key attributes associated with successful designer performance and career development. The survey was conducted based on a structured questionnaire. The ongoing research effort led to 145 responses, originating from engineers and construction professionals, throughout the Greek Construction Industry. The questionnaire was based on international literature and extensive interviews with Greek project engineers. The outcome of the study forms a profile of the competent designer – engineer, and would be important for career

orientation providing at the same time insight for academic study courses.

Keywords
Project Engineers - Designers, Cognitive Abilities, Personality Characteristics, Knowledge, Statistical Analysis.

(Paper, ID 34)

Modeling Knowledge Management Enablers: The Case of Hong Kong Construction Organizations

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Abstract
Knowledge management is a method of acquiring a strategic asset that drives sustainable business benefits. This paper adopts a modeling approach to explore the relationships among the various knowledge management enablers identified in the seminal literature. Using a combination of a focus group with industry practitioners in Hong Kong, and the interpretive structural modeling technique, the paper identifies the direct and indirect relationships among the enablers. The results show that such enablers as: leadership, knowledge management strategy, and organizational culture, have highest influence on other enablers. The paper findings should help construction organizations focus their effort in targeting enablers with highest influence to ensure successful knowledge management implementation.

Keywords
Knowledge Management, Enablers, Hong Kong Construction Practice, Dependence, Interpretive Structural Modeling

(Paper, ID 35)

A Preliminary Study of the Affect of Dimensional Control on the Accuracy of 3D Photogrammetry Modeling

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Abstract
This research focused on what affects the accuracy of a photogrammetric model using a point-by-point comparison based on a series of points whose 3-dimensional position has been established with a total station. The motivation for this experiment came from a need for architecture and building professionals to gather 3D spatial information of a structure easily and accurately without the need of traditional measuring devices such as a measuring tape, surveying equipment, and the use of access equipment. To approach this problem, 3D coordinates of individual points along a building façade were gathered using a total station and then compared to a photogrammetric model of the same façade. Then a set of three different photogrammetric models were generated, each given different set of spatial information prior to their generation as control points. The results showed that the more spatial information given to the model prior to its generation, the more accurate the model becomes. However, the accuracy of coordinate data extracted from the photogrammetric models is still limited and may not be suitable for construction activities that require low tolerance.

Keywords
Photogrammetry, Total Station, Building Façade, Point Cloud, Field Measurements

(Paper, ID 36)

A Network Approach to Investigate Coordination in Construction Projects: A Literature Review and Research Directions

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Abstract
Construction industry suffers from several problems that cause schedule delays and cost overrun. The traditional engineering project management approach focused extensively on optimizing the project process with the ability to plan and manage the technical resources effectively. By developing an optimum plan and allocating time, money, and labor resources efficiently, management has the ability to ensure that a project stays on schedule and within budget. Although this engineering approach has been proven effective in many aspects, there is a lack of

recognition of the importance of participants to the overall success of a project. In this paper, social network analysis (SNA) is discussed as a possible resolution for project management, especially for coordination among the participants of a project. By summarizing previous coordination studies in health care, information technology, and also in construction, this paper points out the possibility and necessity of pursuing SNA in construction. Future directions and recommendations in this area are also discussed at the end of this paper.

Keywords
Coordination, Construction Projects, Project Management, Social Network Analysis

(Paper, ID 40)

The Effect of Curb Appeal on the Property Value of a Single-Family Dwelling

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Abstract
The purpose of this study was to ascertain whether curb appeal has any effect on the property value of a single-family dwelling. Curb appeal in the study was defined as the visual appeal of the immediate outdoor environments of single-family, detached dwellings. The curb appeal of a single family dwelling was measured by the level of maintenance of yards and use of territorial markers on the exterior spaces viewed from the street. Some known predictors of property value of a single-family dwelling, such as total built-up area, number of bedrooms and bathrooms, location, and lot size were included in the statistical model used for the study. A sample of 112 single-family dwellings from 14 neighborhoods was randomly selected for the study in a university town in Texas, USA. Data related to all the variables included in the model was collected. Statistical techniques used for data analyses were Pearson's correlation and General Linear Model. Results indicated that at least one of the factors of curb appeal, measured using territorial markers, has a statistically significant effect on the property value of single-family dwellings.

Keywords
Curb Appeal; Property Price; Single-Family Dwelling; Territorial Marker

(Paper, ID 41)

Key Issues in Procurement and Management of Consulting Engineering Services in Public Sector Organizations

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Abstract
This paper presents a research on identification of key issues in procurement and management of consulting engineering services in public sector organizations. The research is conducted with the help of a case study from National Highway Authority of Pakistan by adopting a six-step methodology. The results show that clients do not plan for risk management before embarking on procurement of consulting services. The results include: request for proposal (RFP) is neither prepared diligently nor its provisions implemented in letter and spirit; scope and time are not managed efficiently; quality-based selection procedures are not used; technical and financial proposals need to be evaluated through expert judgment; decision to appoint same consultant for design and supervision is not based on proper analysis; designs are not vetted for value enhancement; client-consultant relationships require to be based on mutual trust; work methodology proposed in technical proposal need to be implemented in true spirit; and the key professional team members as proposed in technical proposal need to be provided preferably without changes.

Keywords
Design, Consultant, Consultant evaluation, Consultant selection, Procurement

(Paper, ID 42)

Risk Management for Housing Projects Undertaken by Private Land Developers

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Abstract
Pakistan with population of 186 million faces a shortage of 8 to 10 million housing units. There has been considerable expansion in private sector for bridging the existing gap. However, this sector is exposed to numerous risks that if not taken care of, may lead to disaster. The objective of this research is to develop a risk management framework for projects undertaken by private developers. The risks encountered on projects by private developers are identified and prioritized and then their corresponding mitigation measures are established. The influence of one risk on other risks is identified. Twenty-seven (27) identified risks are categorized at country level, market level and project level risks. Top 3 identified risks are corruption, inflation and interest rate, and cost overrun. Mitigation shows that most measures selected for this study are within effective to exceptionally effective range. Identifying the influence of one risk on other risk segregates the influencing risks. This concludes that those influencing risks if mitigated effectively would help in overcoming the remaining influenced risk. Finally, a risk management framework is discussed for projects undertaken by private developers based on the significance of risks and effectiveness of mitigation measures coupled with trends highlighted in risk influence matrix.

Keywords
Construction Industry, Private Developers, Risk, Mitigation Measures, Risk Management Framework

(Paper, ID 43)

Using Energy Interventions to Drive Down Energy Consumption: An Occupant Behaviour Case Study

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Abstract
The reduction of carbon emissions to the atmosphere is widely accepted as a measure to mitigate one of the greatest challenges facing the world, global warming. One of the major contributors identified as contributing to this phenomenon is the domestic market. The domestic buildings are considered to play a significant role as they represent 30 percent of the UK's energy use and produce 15 percent of the carbon dioxide emissions. As part of a UK intervention, studies have suggested behavioural change among housing occupants could be one of the key measures in the drive to reduce the use of energy. This is also expected to decrease the levels of fuel poverty. The aim of this research was to evaluate the effectiveness of the energy advice programme delivered by a UK housing association: Wolverhampton Homes, to tenants interested in energy saving and thereby reducing their fuel expenditure. The methodology incorporated a series of qualitative semi-structured interviews to three different householder groups: a control non-assisted group, a regularly assisted group and the last group supported by energy saving monitoring devices. It was determined that occupants receiving assistance are more likely to realign their behaviour and reduce energy usage within their property if presented with clear a non-technical guidance. Furthermore, the use of monitoring devices as an easy way to visualise energy consumption aided the programme in enhancing the engagement of the tenants in energy saving behaviour patterns. The findings confirm a positive approach that UK local authorities and Housing Associations can adopt in order to reduce energy consumption through influencing occupants behavioural change, promoting energy saving within domestic properties and reducing fuel expenditure.

Keywords
Energy consumption, Occupant Intervention, Occupant Behaviour

(Paper, ID 44)

External Contingency Factors that Affect Contractors' Performance in Developing Countries- A Jordanian Case Study

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Abstract
The performance of construction firms hinges upon the influence of both external environment and firms' specific factors. A less obvious, and possibly a more critical, line of inquiry is that what are the most significant external contingency factors that influence small and medium (SM) sized contractors' performance in developing countries? Using a dataset comprising 409 participants representing the construction stakeholders in Jordan, the factors that attributed to external contingency factors that impact

on SM sized local contractors in Jordan were empirically examined. Findings from the analysis of the data show that all of the main groups of external contingency factors are considered as important factors that having impact on the contractors' performance in Jordan. Client performance was found the most significant group of factors, followed by the consultant performance. Regulations, laws, policies, and high taxes were identified as the most external attributes that impact negatively on the contractor's performance. The study findings have implications for management practice and the government as it could help managers and decision makers of construction organizations to acknowledge the influence of external environment as sources of performance differences among contractors. The study contributes to current debate on the causes of performance differentials among small and medium size contractors firms in developing countries.

Keywords
Contingency Factors, Contractors, Performance, Stakeholders, Developing Countries, Jordan

(Paper, ID 46)

3D BIM Model as a Legal Construction Document

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Abstract
This study will identify the barriers of using a 3D BIM model as a legal construction document. 3D BIM models help any individual visualize a project even when they have no training in the Architectural field. Not only is visual information found in a 3D BIM model, additional information such as Specifications, Architectural and Engineering drawings, Schedules, Cash Flow and Submittals can all be contained within the files. Each file has a Digital Professional Signature that identifies who created the file, the creation date, and type of file. Also contained within this signature is an IP address record which tracks each time the file has been shared on line. By using the Digital Professional Stamp and Signature the information in the file cannot be edited or extracted thus giving a higher level of protection to the professional's work. This is the best way to protect and enforce copyright standards while still allowing universal access users. 3D BIM models are not new as a legal document – it has been used for years in different industries including Fashion Design, Movies, Automobile design, and in particular for the manufacturing of computer mother boards. This type of use is analogous to building design, as it is complicated to produce and built in a similar manner to a construction project with the process being team oriented with many stakeholders. Similarly, it is imperative that construction documents live in a three dimensional culture in order to facilitate coordination and exchange of information. By unifying all documents into a single format the design and construction process of a project can be integrated into a 3D BIM model.

Keywords
BIM Implementation, BIM Development, Claims, BIM, 3D file, Copyright, 3D Patents, Construction Documents.

(Paper, ID 47)

An Investigation of Using Photogrammetry Technology on 3D Digital Recreation of the Historical Progression of a Historic Building

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Abstract
The recreation of three-dimensional "as-built" models of historic buildings can be a demanding process. Contemporary photogrammetry technology allows for easy data collection of a physical space in the form of a point cloud. A study of the technology's effectiveness when applied towards the recreation of a structure is reported here. Primary research was undertaken at a historical building on a university campus in the US that resides on the National Register of Historic Places. Data was collected using various photogrammetry hardware and software, as well as by hand, to be applied towards the generation of a series of digital historical building models. Archival research was conducted to identify existing construction drawings from prior alterations. During model creation, data gathered via photogrammetric means primarily served as a dimensional reference when locating particular architectural features, and not as a means of generating geometry. At present, photogrammetry technology is incapable of serving as the sole tool for as-built and historic model generation, but can be combined with alternative documentation techniques with effective results.

Keywords
Photogrammetry, Historical Building Preservation, Digital Recreation, 3D Modeling

(Paper, ID 48)

Adapting Best Strategic Planning Practices to a Strategic Spatial Planning Model

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Abstract
The concept of strategy is distinguished as one of the widely discussed scientific issues during the last decades. The adoption/application of the expression is considered to be diffused and multidimensional, inevitably causing the emergence of varied definitions and explanations. Generally, strategy incorporates a unity's overall intent and philosophy, having important characteristics and dimensions according to any requirements and necessities. Strategic Planning constitutes an appropriate method of strategic framework formulation and implementation in the Business Management field, which has experienced important acknowledgement and considerable criticism since nowadays. The conceptual framework encompasses multiple approaches and explanations that feature an intended and systematic method of strategic decision formation and making. It is also noted that the basic components of Strategic Planning Framework are the formulation, implementation and assessment of the adopted strategy. Characteristic models of Strategic Planning process are cited form international references, while attempting to analyze the distinct characteristics and differentiations of Strategic Planning in spatial level (Strategic Spatial Planning). The present paper deals with a composite approach of Strategic Spatial Planning model formulation in Greece. The proposed application of a Strategic Spatial Planning model is based on the classic principles of Strategic Planning, incorporating the appropriate adaptions to the spatial level.

Keywords
Strategy, Strategic planning, Strategic management, Spatial planning, strategy formulation process

(Paper, ID 51)

Toward Improving BIM Acceptance in Facilities Management: A Hybrid Conceptual Model Integrating TTF and UTAUT

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Abstract
Recent research has revealed the significance of Building Information Modeling (BIM) implementation in the asset and facilities management (FM) as much as in design and construction sectors. However, the implementation of BIM in FM is only minimal. Thus, BIM acceptance and adoption in FM is still one of main issues in this field. Accordingly, this research aims at: (i) identifying the key factors that influence the widespread acceptance and usage of BIM in facility management; (ii) developing a hybrid conceptual model integrating TTF and UTAUT for enhancing BIM in this sector. The methods that are being adopted in this ongoing research include comprehensive literature review, interviews and survey. In this paper, a summary of interim findings and an overview of the proposed conceptual BIM in FM are presented.

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

(Paper, ID 52)

Utilizing Analytical Hierarchy Process for Contractor Selection in Turkish Public Construction Procurements

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Abstract
The contractor selection decision plays a vital role in the successfully completion of a project. The Turkish public construction sector has a tradition of using the lowest bid as the criteria for contractor selection. However, the selection of a contractor based on bid price alone may lead to the failure of the project in terms of cost overruns, time delays and poor quality standards. Other selection criteria have to be considered in addition to the bid price. Therefore, there is a need for quantitative methods to help project owners for the selection of the best/appropriate contractor. This paper proposes a multi-criteria approach which aims to help the Turkish public construction sector to evaluate and select the best/appropriate contractor based on not only bid prices, but also on other criteria such as economic, financial, professional and technical qualifications.

Keywords
Analytical Hierarchy Process, Contractor Selection, Public Construction Procurement

(Paper, ID 53)

Factors Driving Construction Organizations to Implement Health and Safety within the Gauteng Province in South Africa: A Literature Review

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Abstract
Research about the implementation of health and safety (H&S) within the construction industry is necessary, as it promotes the significant impact of incidents and fatalities on construction organizations. As a result it encourages construction organizations to improve their H&S performances on construction projects. The aim of this paper is to establish the motives behind H&S implementation in construction organizations within the Gauteng Province. This paper presents findings from a literature review conducted from conference proceedings, journals, text books and dissertations. The findings of this study indicate the motives behind H&S implementation as follows: reduced cost of accidents and penalties; increased productivity, profitability and quality; client satisfaction; completion of projects on-time and preserving the image and reputation of the construction organization. These results could assist construction organizations to set H&S as their number one priority, as little attention has been given to the objective of H&S implementation.

Keywords
Construction Industry, Health And Safety, South Africa

(Paper, ID 55)

Key Factors for the Selection of Project Management Consultants

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Abstract
Selecting the appropriate Project Management Consultancy (PMC) firm is one of the prime factors contributing to project success. Different owners use different factors in their selection process based on their own perception. Owners sometimes use ill-defined criteria that do not align with the requirements of their projects. Most of the time, these poor selections become the reason behind the projects' failure. The objective of this paper is to assess the key factors used in the selection process. The selection factors are identified through literature review. A survey is then developed and distributed to 60 professionals in the UAE construction industry in which all factors are compared with each other. Thirty-five completed surveys were collected and analyzed. The Analytical Hierarchy Process (AHP) is used for data analysis. According to the overall results, the highest weight was for the financial package (45%). The technical package had around 34% leaving the commercial and marketing package with the lowest weight of 21%. The top three factors were contract condition, overall fee and duration. On the other hand, the three least important factors were research, development and innovation, the firm's organization and classification and specialty.

Keywords
Project Management, Firm Selection, AHP, UAE Construction Industry

(Paper, ID 56)

State-Of-Practice of BIM Use for Clash Detection in Pakistan

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Abstract
Building Information Modeling (BIM) has emerged as one of the most beneficial platform in the construction industry. It offers various capabilities throughout the project lifecycle, among which clash detection is one prominent feature. Clash detection through BIM helps to check the model for any interference in various disciplines such as architecture, structure and MEP by integrating these

designs into a virtual environment. Studies show that using BIM for clash detection is advantageous and is linked with reduction in time, cost and rework in a project. This research assessed the current state of practice of BIM use for clash detection in Pakistan's construction industry. Findings have shown that overall BIM penetration in the local industry is very low and the use of BIM for clash detection is even less. Young professionals were found to be users of BIM for clash detection. All users agreed that unavailability of BIM outside of their organization was the major factor preventing the use of BIM for clash detection. Resistant to change, internal procedure of the company, and increased designing time required to model for reliable clash detection are some other reasons which do not allow the implementation of BIM for clash detection in construction projects.

Keywords
Building Information Modeling, Clash Detection, Barriers, Benefits

(Paper, ID 58)

Towards Automated Process to Manage Buildings' Environmental Sustainability- A BREEAM Application

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Abstract
Building Information Modeling (BIM) promotes effective information and process integration across lifecycle and supply chain. This integration should comply with an increasingly complex regulatory environment and statutory requirements. This paper presents a valid approach for BIM-based solution to promote environmental sustainability. To achieve this, a methodology has been developed and examined to integrate ICT-based information management systems with environmental sustainability assessment methods. The methodology has been applied to BREEAM assessment method to examine the possibility for automating compliance checking. Although the system performed well in assessing some BREEAM requirements, the aim of fully automating BIM based sustainability compliance checking is currently difficult to achieve. This is due to the fact that many assessment data requirements cannot be processed from a BIM model without human interaction.

Keywords
BIM, Environmental sustainability, BREEAM assessment, Compliance checking, IFC Extension

(Paper, ID 59)

Systematic Literature Review as a Methodology for Identifying Risks

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Abstract
The main purpose of this paper is to introduce the framework of Systematic Literature Review (SLR) as a methodology for research on risk identification. Risk identification is a long and tedious process that often lacks a systematic approach. Therefore, there is a need for a methodical technique to minimize bias and streamline the process of data collection and refinement in risk analysis research. Systematic Literature Review has been used vastly in fields such as software engineering and medicine but has yet to spread to construction management. This paper proposes a framework for application of Systematic Literature Review in the risk identification process of construction research and practice. In order to showcase the proposed methodology, a case study is presented where Systematic Literature Review is applied to identify risks in PPP projects in order to showcase this methodology.

Keywords
Systematic Literature Review, Risk Identification, PPP projects

(Paper, ID 60)

Project Control Using BIM

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Abstract
Project control is vital for the success of the construction project. Building Information Model (BIM) can serve as an excellent tool for monitoring and to present the schedule and cost variances visually. This can be accomplished through a framework that facilitates seamless information flow between BIM and project management system. The framework facilitates usage of three-dimensional (3D) model for actual progress data collection. The automated information flow eliminates manual errors and reduces data formatting time at monitoring step. The framework also enables to present the analysis results using 3D model. This paper discusses the framework that facilitates integration of BIM and project management system. The paper also illustrates the feasibility of the proposed framework

between Revit and Primavera project management software through a residential house project.

Keywords
BIM, Project control, 3D, Visualization, Project management

(Paper, ID 61)

Procedures and Issues within the Contractors Classification System in Saudi Arabia

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Abstract
Research has shown that construction projects in Saudi Arabia have exhibited poor performance for the past three decades. The Saudi construction environment lacks many of the best practices found in more developed countries, such as: prequalification, bonding, and 3rd party insurance. The government's construction relies on the low bid delivery method and prequalified contractors using the Contractors' Classification System (CCS). However, the current CCS does not accurately represent contractors' capabilities and performance. This paper reviews all of the parts of the Saudi CCS, including the workflow and the evaluation criteria. This paper proposes to analyze the current classification system and identify the issues incorporated in the CCS regulations and classification process. This paper summarizes the author's critical review through interviews that have been carried out with key persons in the CCS. Several issues with the CCS are identified, such as: no performance feedback, complexity of the system, and high resource requirements. The findings identify that the current CCS must be modified to be able to accurately reflect contractor capability and performance.

Keywords
Saudi's Contractors classification, Saudi's construction, MOMRA, Contractors' performance.

(Paper, ID 62)

Causes of Cost Overruns in Saudi Arabia Construction Projects vs. PIPS: A University Case Study

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Abstract
Public projects in Saudi Arabia have been experiencing low construction project performance for the past decade. Studies have identified the low-bid delivery method as an important factor in causing such delays. A case study was conducted at a university campus in northern Saudi Arabia to identify causes of cost overruns via interviewed project representatives. In addition, a large survey was conducted of 804 classified contractors and university representatives who identified change orders as the most common factor causing cost overruns in Saudi Arabia. Previous studies showed that some contractors aim to submit low bids to win the competition, and then change orders to reduce their losses. Consequently, low bids also lead to cost overruns. In a comparison using the result of a case study and the results of the Performance Information Procurement System (PIPS), Saudi Arabia's delivery system was identified as a potential cause of project performance issues.

Keywords
Performance, cost overruns, low-bid, Saudi Arabia, Best Value Performance Information Procurement System (BV PIPS).

(Paper, ID 63)

Risk Evaluation in the Arabian Gulf Region (Agr) Construction Industry from Multinational Firms' Perceptions

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Abstract
Risk is an ever-present event on any construction project that causes run up costs, delays, and may eventually lead to project failure. International projects are more challenging than domestic projects as they experience a wider range of risks. With the growing amount of construction in the Arab Gulf Region (AGR) and many more multinational firms venturing into new international markets, limited research exists to identify and evaluate the impact of risks on projects in this area. This paper is intended to provide an overview of the risk associated with international projects and to help international companies to better allocate risks. Seventy-four (74)

risks encountered in the AGR were identified and their impact on cost and schedule performance metrics was evaluated using a risk index. An analysis was then performed on projects for which cost and schedule were both impacted and the correlation between cost and schedule was compared. Using a non-parametric test, some factors were found to have significantly higher impact on cost or schedule. An International Risk Assessment Tool (IRAT) was then developed to help multinational firms enhance their visual ability to pre-emptively identify, address, and mitigate risks.

Keywords
Arabian Gulf Region, International Construction, Multinational Firms, Risks, Assessment Tool

(Paper, ID 65)

Critical Success Factors for Reduction of Cost of Poor Quality from Construction Projects.

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Abstract
Failure in preventing reworks and wastages during work execution in construction projects results in quality failure costs. In most of the projects the quality costs remain hidden because they are not measured, resulting in wastage of more than 25% of company revenues. As whole it is a loss of national resources and the construction industry which contributes significantly to socio-economic development and employment in any country. Critical Success Factors (CSFs) can be made a part of risk management to check the losses on account of quality failure costs or Cost of Poor Quality (COPQ). There are some CSFs having potential to reduce COPQ from construction projects during every stage. They have been identified in this study for the benefit of construction industry.

Keywords
Critical Success Factors, Quality Failure Costs, Cost of Poor Quality, Construction projects, risk management

(Paper, ID 66)

Algorithm for the Determination of Abnormally Low Tenders In Public Construction Contract Bids in Greece

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Abstract
The detection of abnormally low tenders for the tendering of public construction projects is a longstanding issue in the industry. However, the economic crisis and the ever increasing competition amongst the construction companies, has led to an intensification of that issue, especially in competitive tendering schemes, where the project is awarded to the lowest bidder. The aim of the current study is to determine an easy-to-implement algorithm that would objectively detect abnormally low tenders, taking into account the characteristics of the Greek construction industry. The application of the proposed method in 46 public projects which were tendered in the last two years in Greece showed that the lowest bidder would ultimately submit a discount rate 5-10% lower than the initial. A very important issue is the objective determination of the form of explanations that the abnormally low bidders should provide according to the European legislation (2014/24/EU).

Keywords
Abnormally low tenders, Bidding, Public projects, Tender.

(Paper, ID 67)

Identification of Iran's Road Construction Project Risks in Order to Implement Sustainable Development (Pavement Technologies and Construction Activities)

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Abstract
Sustainable development in modern societies is an important debate among decision-makers of the industry. Among industries, the construction industry is among the most important industries in the sustainable development debate due to the extent of its impact on human communities and the global economy. It seems that the main problem in the development of the construction industry is the low number of efficient women at managerial level of this industry. Because a society can be developed that all people have the capacity to develop. However, in the construction industry of Iran, a small number of women have achieve the managerial levels and many of them do consulting, design and office responsibilities. Women, as half of the active labor force, have still not found their rightful place in the field of employment in the construction industry. Review of the existing laws, including the constitution and other laws of the country, shows that women are not legally forbidden to work at management levels. But special individual, organizational, cultural and traditional factors in the form of unwritten rules prevent full participation of women in the development process of industry. But this valuable force during the process of participation and decision-making could have an active role in economic, social and environmental development of construction industry. In fact, the realization of sustainable development in the country is not possible regardless of the capabilities of women and a look at this issue to improve society is necessary. In this paper it is attempted to address different aspects of women's role in sustainable development of the construction industry and barriers against them theoretically.

Keywords
Sustainable Development, Road Construction Projects, Risk Identification, Qualitative Analysis

(Paper, ID 68)

Determination of Polymer Content in SBS Modified Asphalt Binder using FTIR Analysis

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Abstract
Polymer is sometime used in asphalt binders to enhance asphalt pavements performances. However, the quantity or percent polymer used in binders is often unknown because this is proprietary info to the binder producer or supplier, but not to the user, paving contractors or agencies. This has created a complexity in determining how %polymer affects the performance of pavements built using polymer modified asphalt (PMA) binders. To this end, this study has employed the fourier transform infrared (FTIR) spectroscopy method to determine polymer content in an unknown PMA binder. In essence, a neat binder (non-polymer modified base binder) was mixed with four different percentages (known) of Styrene-Butadiene-Styrene (SBS) polymer to produce modified binders. Next, FTIR analysis was performed on the neat/base binder, as well as the modified binders. The FTIR results show that polymer modified binders have two significantly large peaks due to presence of SBS polymer. One peak is for the styrene functional group at wavenumber 699 cm-1 and other peak is for butadiene functional group at wavenumber 966 cm-1 . The FTIR analysis also shows that the peak value increases with increment of polymer content. Using these peak values and the light intensity absorbed by different %polymer binders, a relationship (called calibration curve) between peak ratios versus %polymer was developed. It is hoped that this calibration curve will be useful in determining polymer content in any polymer modified asphalt binder.

Keywords
Fourier Transform Infrared Spectroscopy, Polymer Content, Polymer Modified Asphalt, Quantitative Determination

(Paper, ID 71)

The Awareness and Benefits of BIM in the Construction Industry of Saudi Arabia

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Abstract
Due to the high demand for infrastructure projects and their large sizes a huge deal of construction

opportunities have materialized in the construction market of Saudi Arabia. Building Information Modeling (BIM) is a relatively new technology which is used to support construction business processes. BIM is currently used by construction professionals globally on all types of projects to avoid or minimize costly delays and change requests, among other benefits. However, the use of BIM in Saudi Arabia is still emerging. Given the relatively low level by which BIM is used in Saudi Arabia, a research to investigate its awareness and benefits, amongst other considerations, was conducted. A questionnaire survey was carried out. A total of 342 people were approached to complete the questionnaire and 224 full responses were collected, representing a response rate on 65%. The data was analysed using descriptive statistics where, it was found that more respondents opined that the awareness of BIM in Saudi Arabia is growing. Most respondents agreed that BIM offered many benefits e.g. it makes it easier to develop and manage projects and information quickly. It also helps in linking different activities and stakeholders in the project and gives better and advanced information about the project throughout its life-cycle.

Keywords
Awareness, Benefits, Building Information Modeling, Construction, Saudi Arabia

(Paper, ID 73)

Controlling the Effects of Organizational Risk on Time and Cost in the Construction Industry in the UAE

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Abstract
This paper illustrates the relationship between the organizational risk and construction project success (time and cost) in the UAE (United Arab Emirates). A questionnaire was developed from the literature surveyed and was distributed to 40 people from the construction industry in the UAE. In total, there were 24 respondents (65%). Hypotheses were proposed based on previous literature; these state that there is a positive relationship between independent variables (organizational risk effects, owner effects, contractor effects, consultant effects) and the dependent variable (success factors in the construction project). SPSS was used to establish reliability, and the overall Cronbach's alpha was 0.92. In correlation and regression tests most of the elements showed Pearson's correlation above 0.3, and significance was less than 0.05.

Keywords
Organizational risk, Time overrun, Construction, Contractor, Cost overrun.

(Paper, ID 74)

Spall Damage Repair using 3D Printers: Opportunities and Challenges

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Abstract
Palm-sized spall damage near construction joints on concrete roads is often caused by heavy vehicle. When spall damage occurs, the impact load from heavy vehicle is concentrated in the damaged area. As the damage is getting worse when it is left untreated, it needs to get repaired while damage is small. Common repair methods include placing fresh concrete and getting it cured. This method requires a minimum of 7 days for concrete hydration, which may cause an indirect loss of $ 140,000 according to the US DOT. This paper proposes an alternative way to repair spall damages by taking advantage of 3D printing technology. This method is about pre-fabricating a 3D concrete patch that can be inserted into a damaged area in less than 2 hours. This paper also presents how effectively an inserted concrete patch can resist the lateral loads caused by traffic.

Keywords
Spall Damage Repair, 3D Scanner, 3D Printer, Epoxy-Resin Bonding Agent

(Paper, ID 75)

Safety Effects of Roadway Intersection Lighting

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Abstract
It has been reported that nationwide, about one quarter of the roadway travel commonly occurs after dark and half of the roadway traffic fatalities occurred at night. The nighttime traffic crash fatality

rate is about three times the daytime traffic crash fatality rate. The problem may become worse at unlighted or poorly lighted critical roadway safety spots such as interchange, intersections, and railroad and highway crossing, particularly in adverse weather conditions. This study was conducted to investigate the lighting effects on crashes at Indiana intersections. To quantify safety effects of lighting at intersections, crash modification factors (CMF) were developed using the cross-sectional statistical analysis.

Keywords
Intersection Lighting, Safety, Crash Modification Factor

(Paper, ID 76)

Using Big Data Analytics for BIM enabled Facilities Management

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Abstract
Ensuring safety in facilities has always been a critical job for facility managers. Deployment of data acquisition systems can help to render hazards such as fire, water flooding and burglaries. Building Information Modeling (BIM) is an emerging software technology that is revolutionizing the architectural, engineering and construction (AEC) industry and presents extensive solutions for facility management. In an attempt to monitor and manage buildings data, this work reports upon a system architecture that utilizes BIM and wireless sensor technology to produce a proactive safety and emergency management system. However, integrating BIM data with data readings coming from sensors motes will challenge the traditional approaches to data management and huge sensor data will contribute to the emerging paradigm of big data. In order to process this big data and extract relevant information out of it, a prototype system has been designed that collects real-time sensor data remotely from wireless sensors placed in a building. The results of processing BIM and sensor data in a big data architecture have demonstrated that proposed system can store information in support of safety and property management in a cloud-based environment and can effectively provide data reports to facility managers with the most accurate information needed to make decisions and ultimately attempts to reduce property hazards during the facility management phase of a building lifecycle.

Keywords
Building Information Modeling, Big data analytics, Facility Management, Sensors

(Paper, ID 80)

Performance of New Generation of Engineered Concrete Materials in Infrastructure Applications

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Abstract
Engineered concrete (EC) is a new generation of high performance fiber reinforced composite material designed with micromechanical principles. The high strain capacity while maintaining low crack widths makes EC an ideal material for construction of sustainable infrastructure with high durability, ductility and energy absorbing capacity. This paper presents the structural performance of EC structural components in buildings and bridges. The structural performance of EC link slab in joint-free bridge deck construction and ECC beam-column building frames will be described based on their traditional concrete counterparts. The performance will be judged based on load-deflection response, stiffness, strain developments, crack characterization, failure modes, ductility and energy absorbing capacity.

Keywords
Engineered Concrete, Link Slab, Joint-Free Bridge Deck, Building Frame

(Paper, ID 81)

Approach of Cost Monitoring with 5D BIM on Construction Project

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Abstract
As changes frequently occur during construction phase, they lead lots of variance on the project budget. Cost monitoring is one of the most important techniques to summarize the project cost during construction stage. Effective construction cost monitoring allows project manager to know the status of project cost by time which can be identified early enough to take corrective measures and avoid cost lose. Current cost monitoring approach replies mostly

on manual work, which is not efficient and inaccurate. With the development of building information modeling (BIM) in construction industry, it's expected to enhance the efficiency of cost monitoring and payment visualization, while the BIM including cost information is called 5D BIM. This research proposed an approach to monitor project cost and payment by linking the cost and payment information to 3D model, enabling record of cost update automatically by time. This approach includes combination of WBS and BOQ for cost monitoring by coding system with software Dynamo. Illustrative example will be implemented to test the approach with real data from one exist construction project. This approach will distinguish paid and unpaid elements in 3D model by different payment stages. Secondly, corresponding S-curve based on payment stage is provided. From this 5D model, cost and payment can be easily visible in building model at different progress time. Result shows that the proposed approach improves the efficiency of cost monitoring significantly and make the progress payment visible by times. Finally, the discussion and limitations and expectation on the further study are provided in the end.

Keywords
5D BIM, Cost Monitoring, Payment Visualization, Dynamo, Progress Payment

(Paper, ID 82)

Evaluating the Selection of Construction Methods used on Building Projects Using Performance Objectives

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Abstract
This paper examines the factors affecting the selection of construction methods and materials on building projects. This examination stems from the growing need for accommodation and housing, innovation and the use of new construction methods and modern building materials, to reduce the time required for construction, lowering the cost of construction and improve the quality of construction. Selection of appropriate construction methods for the project is a key determinant of high productivity. But usually, this selection process is executed without an efficient, systematic approach, affecting the productivity of projects. To provide appropriate and suitable solutions, the five most critical factors considered in selecting construction methods in building projects were identified through literature review and verified through an interview process with construction industry experts in five countries in the Middle East namely Iran, United Arab Emirates, Turkey, Egypt, and Qatar. For the purpose of this research, the most common construction methods and materials often found in the six main stages of building projects namely Foundation, Structure Framing, Wall, Roof, Floor, and Façade were selected. The level of usage and criteria for selecting the different construction methods and materials were determined by classifying and analyzing data provided by construction managers of 200 building projects with varying levels of education and experience in the study area i.e. in the Middle East. The results of the data analysis on the degree of usage and criteria for selecting different construction methods and materials demonstrate the significant role and impact of quality and time in the selection of construction methods among other factors. On the other hand, the cost and ease of construction have less impact while the availability of method and skill have the least effect on the selection of construction methods by construction managers of building projects.

Keywords
Building Project, Construction Method, Cost, Ease of Construction, Quality, Time

(Paper, ID 83)

Resource-Constrained Project Scheduling using Evolutionary Algorithms

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Abstract
The multi-mode resource-constrained project-scheduling problem (RCPSP) is perhaps the most difficult combinatorial optimization problem in project management. This is because the RCPSP includes multiple and conflicting objectives and constraints e.g., leveling the resource profile while keeping resource usage within availability constraints and the project length within acceptable limits. The solution space increases significantly in size as the number of activities and execution modes increase while strict resource availability limitations may extend the project length considerably leading to a wide range of possible activity start times. In such a problem environment, the employment of evolutionary algorithms is necessary to approximate optimal solutions. In this work, a comparative performance analysis of five evolutionary algorithms for solving the RCPSP is presented. The analysis aims to provide insight regarding the algorithm performance in terms of the solution quality and efficacy in model design, implementation, and parameter tuning. The algorithm implementation is done in Matlab environment to facilitate the analysis process. Evaluation results indicate that Genetic Algorithms and Particle Swarm Optimization can provide optimal or near-optimal solutions in most

cases, Harmony Search and Simulated Annealing algorithms respond well in medium size problems while Ant Colony Optimization presents a lower performance compared to other algorithms.

Keywords
Resource allocation, Resource Leveling, Evolutionary algorithms, Project scheduling, Multi-objective optimization

(Paper, ID 85)

Study the Effective Location of Shear Wall and its Cost of Multi-story Building under Seismic Loading in Iraq

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Abstract
The present research aims to study the response of multi-story framed building subjected to seismic loading. The finite element dynamic analysis is applied through using SAP2000 software and using nonlinear static analysis in the study. The study includes calculating the free vibration analysis and the forced vibration due to earthquakes loading. The main factors considered in this study are the location of the shear wall and the type and economy cost of these types. The record of earthquake in Iraq is applied on a three dimensions multistory building with practical size and the response is determined and discussed. In our study will search the effective of the location and type of shear wall in the response of the building under earthquake loading and also we discuss the economy state for each case and compare between it to find the perfect case have good results under seismic loading and also have good economy cost. In our study, search the free vibration analysis and also can make forced vibration analysis under seismic loading. The study also uses multistory building above 15 story and the shear wall install along the building length and different location in center of the building, external corner, internal corner, and each parallel side in external and internal the building and also using different shape of share wall like angle and rectangular.

Keywords
Seismic Load, Shear Wall, Cost Management, Nonlinear Static Analysis, SAP2000

(Paper, ID 86)

The Impact on Environment and Decision Making Between Similarity of Design and Materials Difference through BIM

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Abstract
The purpose of this study is to comparison between two buildings have same design but the material entries are different in design stage. Considers Green Building Information Modeling (GBIM) is an effective method for materials analysis and to study impact the materials on environment like Mass, Acidification, Global Warming, Ozone Depletion, Smog Formation, Eutrophication and Primary Energy Demand. This study includes documentation regarding Building Information Modeling, Green Building Information Modeling. The primary case study will be two virtual buildings were considered in this report by using Revit software created two virtual buildings (3D) it has same design but the material entries are different and how can we assess the environmental impact of building materials early and make decision in the design process.

(Paper, ID 87)

An Investigation into the Building Information Modeling Software Tools

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Abstract
The nature of construction industry includes uncertainties, which result to rework, interfering, waste and other relevant concerns. It has been some decades that we are deploying computer aided programs to minimize the uncertainties and increase the predictability and confidence in Architecture, Engineering & Construction (AEC) related works. Building Information Modeling (BIM), as a new and more intelligent approach in involving the physical and functional characteristics of a building and

organizing a digital representation of that, is nowadays being deployed by many construction industry professionals across the buildings and infrastructure sectors. In this article we aim to compare a number of most recognized construction management BIM-based programs by considering some of the most important criteria and measures that any BIM construction management software application should meet to satisfy the managerial needs and requirements of the project management team. The required data to put into analysis in this article is gathered by a series of technical tools from variety of resources including expert users, project managers, and technical reviews. The result of this research will enable project managers and site coordinators to select the most suitable BIM based construction management software for their project in accordance with the technical and implementation issues and also financial considerations.

Keywords
Building Information Modeling (BIM), Project Management, Construction Management Tools

(Paper, ID 88)

Impedance to Innovation Practices in the Ghanaian Construction Industry Consultancy Services: The Perspective of Quantity Surveying Firms

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Abstract
The construction industry is recognized as a universal driver of the economy, nevertheless it is berated for its reluctance to innovate. However, firms that adopt and boost innovation are bound to increase productivity and gain competitive advantage over their rivals. The rate at which innovation is adopted in Ghanaian quantity surveying (QS) firms is very slow and very alarming to the industry's stakeholders. This motivated this study to empirically identify the challenges impeding innovation adoption amongst Ghanaian QS firms. Quantitative research approach and census sampling technique was adopted for this study. Mean score analysis aided by Friedman test and Wilcoxon signed-rank tests were employed in the analysis. The results indicated that internal impediment has the highest impedance on innovation in the QS firms followed by external and demand impediments respectively. This paper importunate request for management of QS firms, Ghana Institute of Surveyors and the Government of Ghana to formulate policies, and promote measures to enhance innovation adoption. The main contribution of this study is the classification of all the challenges impeding innovation in the Ghanaian QS firms into three sets of groups and also expanding the knowledge base of these identified impediments.

Keywords
Innovation, Quantity Surveying, Impedance to Innovation, Ghana

(Paper, ID 90)

Identification of Risk Factors for Wind Energy Investments in Turkey

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Abstract
As the non-renewable energy sources are rapidly being depleted, policy makers in many countries have started to attach more importance to renewable energy sources in order to satisfy the growing energy demand. Turkey is one of the fastest growing countries in the world with rapidly growing demand for energy. New investments are needed in the renewable energy sector in order to satisfy this increasing demand. The Turkish government leans towards renewable energy but does not have enough funds to invest in power plants that can produce renewable energy. As a result, the Turkish government has used the Built Operate Transfer (BOT) project delivery system to produce renewable energy. One of the popular renewable energy sources in Turkey is wind. Investments to produce wind energy can be feasible options for investors, but the risk factors stemming from the macro environment as well as project level risks should be identified. The objective of this study is to identify the risk factors for wind energy investments in Turkey. For this purpose, the risk factors are determined by extensive literature survey, thereafter several interviews are conducted with experts to finalize checklist. The findings of this study are expected to guide the investors in Turkey.

Keywords
Project, Wind, Risk Factor, Renewable Energy, Investment

(Paper, ID 91)

Construction Project Management in Developing Countries: The Case of International Construction Projects In Kenya

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Abstract
The aim of this paper is to investigate the applicability and relevance of various project management approaches, tools and techniques in international construction projects in developing countries. It uses Kenya as a case study. Kenya is planned for intense development of roads, railways, ports, airports, water and sanitation facilities. Construction projects have become international affairs with multi-cultural teams located in multiple countries. The unqualified adoption of indigenous or western project management practices is strongly discouraged. The cultural and political aspects need careful consideration along with other factors such as technology transfer, skilled labor disparities, size, novelty and type of the projects to ensure the project's success. Understanding and successfully managing cultural differences can bring several advantages to the projects. On the other hand, problems arising from cultural differences can cause conflicts, wastage of resources and delay of construction. The project management approaches to be used must reflect global realities and provide local solutions. The paper gives a theoretical basis and recommendations to construction project managers for a harmonious working environment.

Keywords
Developing countries, Culture, Management techniques, Expatriate, Globalization, Performance

(Paper, ID 92)

Evaluation of Causes of Construction Waste in Residential Building Projects: A Case Study of Kolkata

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Abstract
Material waste has been recognized as a major problem in the construction industry that hinders the efficiency of the projects and also impacts the environment. With increasing demands in infrastructure projects especially residential projects in India, a large amount of construction and demolition (C&D) waste is being produced. These projects mainly employ conventional construction methods rather than more efficient prefabrication technology. This research focuses on identifying and assessing the main causes of C&D waste in residential projects in Kolkata, India. Twelve major causes noted from literature and case studies were used to develop an analytic network process (ANP) model for further evaluation of their relative share towards waste generation. Twelve industry experts judged the causes and poor management emerged as the main concern followed by design change and use of unfit products. This knowledge may help in framing the recommendation for waste minimization by selecting the best option in various stages of design and construction of residential projects.

Keywords
Analytic network process, Construction waste, Prefabrication, Residential project, Waste minimization.

(Paper, ID 93)

Examination of DEVap Air Conditioning Systems to Evaluate Energy Efficiency

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Abstract
This research examination and study looked at the desiccant-enhanced evaporative air conditioning (DEVap) system and how this system can save energy and eliminate environmental concerns during operation of the system. Why has this system suddenly become an interesting possible alternative to the standard direct expansion air conditioning system? As with any new technology, skeptics will be forthright and bringing this into the conventional air conditioning market will create risk and obstacles to overcome (Kozubal, et al., 2011). In order to determine how this new technology could be considered for the air conditioning market, the following general topics were assessed through three straight forward questions: (1) Will the DEVap system work in any climate situation? (2) Can the DEVap system reduce monthly energy usage/cost and lifecycle costs? (3) Will the DEVap system reduce environmental concerns? The answers to these three questions basically tell anyone considering the use of the DEVap technology the important information required to make a decision based on

sound engineering documentation and principles (Woods and Kozubal, 2012).

Keywords
Energy, Climate, Environmental, Lifecycle

(Paper, ID 94)

Identifying Cost Impacts to Public Storm Water Infrastructure for Campus Development

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Abstract
This paper will explore the current expansion of college campuses and the impacts that occur to the aging storm water infrastructure. In the past 20 years' colleges have increased in population and there is a growing emphasis being placed on education with the current high school student. To entice new students in this competitive market many universities have elected to expand and update their facilities in an effort to increase their enrollment. By doing so they have exceeded the capacity of the existing infrastructure so to add in their growth they have to develop plans to improve the systems and reduce their overall impacts on the environment (Too, 2012). Storm water structures are a system of pipes and retention practices that are used to remove excess water from an area that could not handle the volume naturally in a time that would not place individuals or property at risk. As pervious areas are claimed by an ever growing society and impervious structures laid down the environments ability to dissipate the waters are reduced and the storm water systems means needs to be increased. Prior to any expansion there should be a well-choreographed plan in place to achieve the goals of growth, which do not impact the surrounding areas. Failure to plan can place lives, property, and the contributing water systems at risk of floods, erosion, and contamination. Understanding budgets and planning timelines are essential to planning for this growth. Most campuses plan for 10 years of growth but release work within a fiscal year budget. Combine this with local planning review times that can exceed 6 months for an environmental permit and one can see that there is a balancing act between the funding and the planning and release of contracts.

Keywords
Storm water, Environmental, Facilities, Site, Planning

(Paper, ID 95)

Exploring Solar Water Heating Systems and Uses at Ft. Stewart, Georgia USA

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Abstract
This research was performed to explore the different options available for solar water heating. Renewable energy technology has become more popular. As the world looks to reduce energy costs and carbon footprints, this type of technology is being used more frequently. This technology has been around for over 100 years, but developments for this technology have been intermittent due to different obstacles it has faced. It is important to understand how the different systems work and the types of systems available. This research broke down the basic components that are available for solar water heating in order to get a better understanding of the systems as a whole. Solar waters heaters are capable of providing 40% to 80% of a building's annual water-heating needs (Clyne, 1999). The wide range of savings is not only a result of the different types of systems available, but also because of the different environments that this technology can be used in. The efficiency of these different systems was explored to find the best uses of these different systems in the various environments. A real world problem was discussed and different solutions were given based on the research performed on solar water heating systems.

Keywords
Collectors, Thermosyphon System, Drainback System, Photovoltaic Pump

(Paper, ID 96)

Managing Workforce Diversity at Gulf Cooperation Council Construction Sites

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Abstract
Construction projects at the Gulf Cooperation Council (GCC) countries consist of a diverse and multi-cultural workforce. Successful management of construction projects requires effective communication among this diverse workforce. It is estimated that non-national employees constitute more than 50% of the workforce in some GCC countries such as Kuwait, Qatar, and United Arab Emirates (UAE). Thus, it is important to understand the nature and influence of cultural diversity at GCC construction sites. This paper investigates previous studies to identify potential active cultural differences in GCC countries as well as their influence in avoiding undesirable outcomes. The investigation revealed three active cultural differences: high power distance, collectivism, and uncertainty avoidance. Based on the results of this study, practical recommendations that can be used as a guide for managing active cultural differences at GCC construction sites have been suggested and is presented in this paper.

Keywords
Active Cultural Difference, Construction Management, Construction Safety, National Culture

(Paper, ID 100)

Case Studies of Energy Efficiency Housing in South Australia

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Abstract
In July 2009, the Council of Australian Governments announced the agreement of National Strategy on energy efficiency to reinforce the adoption of energy efficiency across the Australian economy including the residential sector and move towards a lower carbon future. South Australia has promptly responded to the trend of being green in building development. However, lack of attention has been given to the residential housing in terms of the perceived benefits and actual performance based on occupant's evaluation. This paper aims to fill up the gap by using two energy efficiency houses as case studies by means of face-to-face interviews. Each case not only demonstrates the incentives and barriers of this type of housing, it also attempts to identify the possible improvements and strategies to promote the affordability of energy efficient housing in South Australia. Whilst the financial savings in energy bills have been affirmed as one of the major incentives that can assist in promotion to a wider community, energy efficient housing is still generally considered not as an affordable option due to a significant cost difference as compared with conventional housing. The interviewees advocate that both the government and the builders are considered to be a catalyst in promotion for wider acceptance. It is suggested that the state government should provide more financial incentives to make it more affordable.

Keywords
Energy Efficient Housing, Affordable Housing, South Australia

(Paper, ID 101)

Achieving Project Outcomes for Construction Frameworks

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Abstract
The collaborative construction frameworks have been developed as an innovative procurement in the major countries such as the UK and South Africa to create long-term relationships between clients and contractors to improve project outcomes. Previous research undertaken into highways maintenance projects set within a major county council in the UK has confirmed that such collaborative relational procurement methods can improve time, cost and quality of construction projects. To ensure that the expected project outcomes can be achieved, further research is conducted into the same significant case to develop a contractor performance model through identification of performance drivers at the procurement and construction phases. Factor analysis and central tendency statistics from 100 questionnaires and content analysis using node values from 10 interview transcripts confirmed that long-term relationships, financial and non–financial incentives and stronger communication were the sociological behavior factors driving performance. The interviews also established that key performance indicators (KPIs) could be used as an operational measure to improve performance. Applying the sociological and operational constructs of the performance model, client project managers can effectively collaboratively drive the performance of construction frameworks to achieve project outcomes. Further research should be conducted on building projects so that the model can be further tested and become more robust. This research can also be expanded to other countries to confirm its applicability in international settings.

Keywords
Construction frameworks, Project outcomes, Performance model, Procurement and construction phases

(Paper, ID 102)

An Innovative Methodology to Achieve Sustainability of Construction Projects in Australia – A Conceptual Study

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Abstract
The sustainability at construction can be defined as the effective project delivery without compromising the project cost, environmental and social impacts. However, sustainability at construction is often conceded due to several limitations in data collection, assessment and the project specific constrains. Eventually majority of the construction projects are directed towards achieving only one sustainability aspect in construction. Stakeholders in construction who are passionate about sustainability recognize the importance of maintaining a balance between the major sustainability aspects in construction. The current study has made an attempt to investigate and criticize the current tools and studies available to measure sustainability in construction. Based on the findings a new methodology is suggested to enable effective decision-making, which allows the integration of sustainability aspects in construction. The study is also a part of the initial research work on developing a sustainable toolkit to achieve effective decision making at construction.

Keywords
Sustainability, Construction, Cost, Environmental impacts, Optimization

(Paper, ID 103)

BIM a Technology or Something More

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Abstract
The implementation of Building Information Modeling (BIM) is revolutionizing the construction industry; transitioning from 2D to the nD digital world. Although implementation has increased, there remains confusion towards the term 'BIM'; whether it should be considered a term expressing a form of technology or something more. This may appear as a simple question; however, there remains no definitive definition of BIM which has resulted in a variety of perspectives, influencing different methods of its implementation. This paper investigates current BIM literature that explores its implementation in the industry, in an attempt to shed light on the different perspectives regarding the term. With a better understanding of the term of 'BIM', organizations will be better equipped with understanding how it should be managed when integrated into their construction projects.

Keywords
Building Information Modeling, BIM, Construction, Technology

(Paper, ID 104)

Benchmarking of IT based Tools for Site Security, Safety and Communication on Construction Worksites in a Metropolitan city of a Developing Country

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Abstract
In this modern era of Information Technology (IT), where a number of applications of IT can be found easily in different sectors the significance of IT also

emerges in construction sector as well, where different contractors have shown their tendency to employ the latest technology as well as to equipped them efficiently; enhancing the safety, security and the process of communication on the construction worksites. Pakistan as a developing country, is trailing behind in the field of technology unfortunately. To benchmark the usage of IT based tools for site security, safety and communication, this study initiates with the literature review that assists in listing of significant IT based tools. The research work comprises of two parts, first part constitutes of assessing the utility of IT tools on the basis of three subject domains i.e., site safety, site security and communication on worksites. The other part of this study is targeted to assess the impact of IT tools on overall work productivity on cost effectiveness, availability of tools on worksites and to identify the level of skill required by the workers in using IT Tools. A structured questionnaire is designed and used for data collection purpose. In total, 13 questionnaires were filled on the basis of site based interviews and site observations. A 5-point scale is used in the questionnaire to get the respondents response. This study concluded that due to the global economic competition, construction firms are beginning to adopt IT tools and explore different possible options for improving the delivery of their products and services. It is recommended to initiate programs in local sector to create awareness regarding different IT tools helping in all the three subject categories; safety, communications, site security.

Keywords
Information Technology, Technical Tools, Site Security, Site Safety, Communication

(Paper, ID 105)

An Assessment of Soft Factors Leading to Rework and its Impact on Project Performance-The Experience of Pakistani Construction Industry

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Abstract
In a typical construction project, there is a lot of diversified activities, in a complex environment that involves multiple levels of trades, suppliers and installers, and where many activities take place simultaneously, the likelihood for errors, omissions and poor management practices can often lead to quality failures, which must then be reworked. Rework is a general problem in the construction business all over the world but the problem tends to be bigger in developing countries such as Pakistan. Thus, project management role can provide effective fulcrum for tracking of rework occurrences and thereby implementing suitable management measures for reducing the resultant impacts on productivity and project performance. This study has been carried out to assess the soft factors leading to concrete rework and its impact on project performance based on primary data obtained from various building construction projects in Karachi. The analysis of responses led to drafting of conclusions and recommendations. The major findings of the study are: As far as the broad umbrella soft factor "Human resource capability" is concerned the subset factor "goal divergence by any of the stake holder" has been determined to have the most severe effect on cost and time, whereas "lack in experience of consultant and contractor" has been deduced to have most severe effect on quality. Similarly, the broad umbrella soft factor, "Leadership & Communication" the most severe impact on cost is the subset factor "client desired for modification of architectural design after execution", the subset factor "late design change" has the most severe impact on time, and the subset factor "conflict in contract documents" has the most severe impact on quality.

Keywords
Soft Factors, Rework, Leadership & Communication, Productivity and Project Performance

(Paper, ID 106)

Calculating the Cost of Poor Quality

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Abstract
Quality improvement is essential, not optional, for an organization competing in the current global marketplace. An organization must constantly improve its performance in order to stay competitive. The cost associated with poor quality considerably affects an organization's ability to compete. The cost of poor quality (COPQ) can account for 15 to 30 percent of a company's overall costs. Architectural finishes in a construction project amount to a considerable portion of the total value of work. This paper focuses its attention on the cost of rework from the subcontractors in charge of architectural finishes in a public sector construction project in South Florida. The objective of this paper is to measure the cost of poor quality; identify and prioritize rework processes most in need of improvement and define appropriate actions that can be implemented to reduce COPQ in an ongoing construction project. The data analyzed is a sample list of unapproved work items extracted from the project punch list. The cost of this specific portion of rework is then analyzed through the use of quality management tools such as Pareto chart, Cause and Effect Diagram, Histograms and Flow-Charts. This leads to identifying those work items most in need of quality improvement. This paper concludes that the cost of poor quality in this job is caused by two main factors (i) Bad quality of Execution- Installation; 55% of the cost of the repairs (ii) Material damaged after installation; 42% of the total COPQ. Measurement of COPQ can be utilized to reduce the company's overall costs.

Keywords
Quality, Cost, Rework, COPQ

(Paper, ID 107)

Fire Emergency Response Mechanism in Commercial Buildings in Karachi

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Abstract
The fire is a type of emergency followed by a path of destruction that occurs spontaneously at a job site or working office with no warning whatsoever; damaging and eradicating every resource in the sight. To prevent such damages and property loss while protecting the employees from fire requires a fire emergency response mechanism. However, most of the firms are blinded by their successful performance, neglecting the safety and protection of their workforce. This study examines the current level of response mechanism practices conducted in commercial buildings in Pakistan during fire incident, where the results indicate that fire proofing components and evacuation plans usually does exist in majority of commercial buildings, however, their effectiveness did not meet the required standards due to the lack of inspection and endorsement enforced by the fire protection authorities existing within Pakistan.

Keywords
Fire, destruction, safety and protection, fire-proofing components and evacuation plans

(Paper, ID 108)

Building Relocation Case Study in Pakistan

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Abstract
The building relocation system is primarily a new tool and technique emerged significantly in the field of construction management, focused on repositioning the structures to utilize the vacant space in an urban city for another structure to fit in. However, many building constructors discourage this system as they are considered a part of our environment, which may include streetscape, fences, gardens etc. and removing these buildings from these settings disorients the infrastructure planning of the city. Subsequently, the relocation should only be appreciated in cases of saving a heritage or normal building as a last resort, encouraged by the New Zealand Historic Places Trust (NZHPT) for preserving significant heritage buildings and structures by removing from their original sites while keeping their originality. Similarly, this study focuses on the case study of Nusserwanjee Building, a century old cultural heritage in the city of Karachi, Pakistan, said to be demolished, yet preserved by

moving the structure from the city center to the open outskirts of the city, near beach, to rehabilitate and transform it into the educational institute standing today. Currently, this building is the South Asia's first ever relocated building where this study distinguishes the cost comparison b/w development of a new institutional structure and displacement of an old structure as it was converted into an operational institute, along with the new innovation and techniques introduced by the architects and contractors during the construction phase.

Keywords
Building relocation system, cultural heritage, institutional campus.

(Paper, ID 109)

Safety Training Approach: Evaluation of the Effectiveness Towards Achieving a Zero-Accident Workplace

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Abstract
A zero-accident working environment can happen by having an overall safety program, which coincides with the philosophy. This overall safety plan comprises of safety policies, which can be implemented by conducting Safety trainings. This is adopted in construction companies that had been showing excellent results lately. The success is because the program is being monitored and results had been reincorporated to the program. However, there are accidents that occur every day and this study has attempted to find out from individual construction professionals that how much time and effort is put into monitoring safety and increasing awareness. A questionnaire survey was conducted from the local construction companies of South Florida. The questionnaire inquired about company safety goals, safety meeting, OSHA (Occupational Safety & Health Administration) citations, health & safety orientation, program/manual and follow-up system. Respondents were mostly owners, supervisors, project managers and superintendents. Majority of companies do have a safety program which involves education and safety prevention. South Florida is becoming more and more involved in a national movement towards zero accidents in order to have an effective zero accident policy. However, some organizations argued that time constraints and cost were the biggest obstacles for ensuring safety, most companies with less than fifty (50) employees do not have a set formal safety standard. It is recommended that construction companies need to set aside monetary resources and time to create and implement employee safety training. It is also recommended that management must lead by example by setting the standard on how employees must act safely on the job site.

Keywords
Zero Accident, Safety Training, Occupational Safety & Health Administration

(Paper, ID 110)

Understanding the Relevance of Biological Cell Control Theory and Cell Control Mechanism For Solving Construction Quality Problems in a Tunnel Construction Project

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Abstract
With construction industry grappling with quality issues despite implementing ISO certified Quality Management Systems (QMS) there is a need to infuse fresh perspectives to manage quality in construction. This paper aims to understand the relevance of a fresh perspective based on biological cell theory wherein the cells achieve astounding accuracy with minimal defects in replication to achieve a multicellular structure. For this purpose, the paper employs a metaphorical approach, essentially comparing the current quality management practice in construction with the procedures used in biological cells to generate new insights on how to solve the quality problem encountered in a tunnel project. A reflective analysis of a case study is conducted using this approach using notions of embedded design, uniform rate of cell proliferation, and biological cell control cycle with gated checks that induce a state of senescence for misbehaving cells. The findings show promise in that new insights can be generated through such reflection through a better 'embedded design': The significance of a lack of an initial cell for replication, the importance of incorporating a gated check by integrating quality management with time management to ensure the efficacy of cell replication to eliminate quality issues, and a multi-stage approach to cell proliferation rates all arose through this approach. Suggestions for further work include establishing the acceptability, the suitability, and the feasibility of the identified strategies.

Keywords
Biological cell theory, Cell, Construction, Metaphor, Quality Management, Rate

(Paper, ID 111)

Integration Of Tablets And Smartphones In Construction Projects: Challenges And Solutions

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Abstract
The construction sector has a high degree of decentralization of information, a high degree of mobility and a high rate of mobile content access in comparison with other big industries. Consequently, there are trending investigations for implementing mobile devices such as smartphones and tablets in the industry. This paper is aimed at reviewing the main technologies related to mobile devices as well as suggesting solutions to some of the main challenges of the construction sector by adopting smartphones, tablets and their latest technologies. A literature review was performed highlighting the main technologies that currently can be used to develop solutions to construction projects such as Augmented Reality (AR), Building Information Modelling (BIM), Geographic Information Systems (GIS), Cloud Computing (CC) and Mobile Cloud Computing (MCC). It was found that these technologies have been merged to provide solutions for complex challenges in construction projects. In addition, a case study was analysed where BIM, GIS, and MCC were implemented to successfully address the project's requirements. The review of the literature provided enough information for this paper to suggest solutions to some of the main challenges in the construction sector, namely: materials, finance, design, knowledge and management.

Keywords
Mobile Cloud Computing, AEC Sector, Augmented Reality, Building Information Modeling, Geographic Information Systems

(Paper, ID 112)

An Empirical Study on Training Provision for Knowledge Management in the Kingdom of Saudi Arabia's Construction Industry

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Abstract
The growing popularity of knowledge management (KM) in the construction industry has, unfortunately, not been matched by parallel empirical research in training and benefits of KM for construction industry in the Kingdom of Saudi Arabia (KSA). This paper discusses the nature of training provisions for KM that currently exists in KSA construction industry. Given the relatively new and unexplored nature of the research problem, qualitative research method was adopted to collect and analyze data. Results are based on the analysis of data from 16 professionals from 10 construction organizations. The data was analyzed using content analysis. This paper concludes that training interventions are a complex and context embedded activity. The current study's results suggest that for effective implementation of KM strategies, there is an urgent need for KSA construction industry to develop and deploy appropriate KM related management-training programme(s). Leadership plays an important role in breaking down barriers in achieving KM strategies. Therefore, there is an urgent need to develop and deliver a bespoke training framework to address, improve and measure the effectiveness of leadership skills for implementing KM related change initiatives in the KSA construction industry.

Keywords
Construction Industry, Knowledge Management, Training, Kingdom Of Saudi Arabia.

(Paper, ID 113)

A Systematic Review Of Green Buildings As A Tool Towards A Sustainable Construction Industry

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Abstract
"Green" has become the stenography term for the concept of sustainable development when applied to the construction industry. Sustainable; or green buildings are developed with aims to reduce the negative environmental impacts and to improve construction design, and operation systems. The last decades have perceived a massive number of researches and studies in sustainable buildings. The objective of this paper is to present a critical review of literature related to sustainable buildings. The major aspects are scope and definition of green buildings considering the three sustainability bottom lines, with various accomplishment approaches. Moreover, assessment tools of green buildings are seen as a way to increase the demand for sustainable

buildings. It is found that the majority of studies focused on environmental aspects whilst other aspects are commonly overlooked. Occupants' satisfaction requirements and the associated measures are briefly reviewed. The findings emphases the importance of the life cycle assessment approach, and also indicated that there is a transfer to widen the scope from only directing and focusing on the building itself to the linkage between building and its users.

Keywords
Building Performance, Energy, Environmental Aspects, Sustainability, and User Satisfaction

(Paper, ID 114)

Identifying Worksite Intervention Strategies to Improve Construction Workers' Nutrition: A Review of Literature

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Abstract
The nutrition of construction workers appears to be understudied despite anecdotal evidence that suggests that it is closely linked to health and safety (H&S) performance and productivity of the workers on construction sites. The objective of this paper is to identify possible worksite interventions to improve the nutrition of construction workers. A review of literature based on both South African and international context was conducted from journal, conference proceedings, books, magazines, theses and dissertations. Findings revealed that supplementary feeding programmes, nutrition education and environmental and/organizational changes could beget better nutritional behavior among construction workers, whose food choices comprise mainly of fast-foods and fizzy drinks. The study emphasizes the need for nutrition of construction workers to be given adequate consideration on worksites.

Keywords
Construction Workers, Health And Safety, Nutrition, Productivity, Workplace Interventions

(Paper, ID 115)

Building Information Model for Infrastructure: Challenges and Benefits

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Abstract
Infrastructure has a major impact within our economy, from improving our growth to providing jobs for the general public. In the UK, infrastructure is being heavily invested in for the next 20 years as the population is growing and current infrastructure is undergoing wear and tear. Providing efficient and cost effective construction of infrastructure has been an issue for many years now which is why level 2 Building Information Model has been made a minimum requirement to use within the infrastructure sector by the UK government by 2016. The Building Information Model brings a variety of gains within the construction of infrastructure sector from improving collaboration within the entire team before the construction starts to providing better asset management post construction of the asset.

Keywords
Building Information Model, Infrastructure, AutoCAD, 3D

(Paper, ID 116)

Feasibility Study Considerations for Transport Infrastructure Performance: A Desk Study

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Abstract
Transport infrastructure projects are complex, stochastic and fraught with uncertainties, which if not accurately predicted, can lead to inadequate assessment and management of risks and over time, poor performance in terms of costs, and associated expected benefits from implementation. The objective of this paper is to identify critical factors which should ideally be included in feasibility studies for adequate prediction of performance of road projects while in operation. A thorough in-depth desk study was conducted using extant literature (from conference proceedings and journals) and reports on feasibility and performance of transport infrastructure projects in Africa and world over. Findings revealed that effectiveness of procurement and financing strategies was the most considered factor during feasibility studies, among the sampled studies; followed by public participation, role of national government and traffic demand factors. Other factors included project environment, planning for operations and effectiveness of plans. These findings will be beneficial to investors who need assurance of the worthwhile performance of transport projects in which they intend to invest in. The study will inform selection of worthwhile projects among alternative and competing options which need to be implemented with limited resources.

Keywords
Forecasting, Infrastructure, Performance, Transport

(Paper, ID 117)

Human Factor Related Constructs to accompany Extant Construction Business Marketing Frameworks

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Abstract
Marketing is playing a key role in overcoming growth, survival and profitability challenges facing many businesses today. However, the application of marketing in the construction industry is challenged by lack of human factor constructs in extant construction marketing frameworks. This paper adopts the Technology Acceptance Model, the Theory of Planned Behavior and the Typology of Strategy Model in examining relevant human factors to ascertain their effect on marketing in the construction industry. Findings reveal that factors such as acceptance, behavior and strategic orientation are human related factors that greatly affect marketing in construction. Again, evidences point at construction education as the culprit of the human factor challenges confronting marketing in construction. This paper, therefore, proposes human factor constructs based on appropriate theoretical lens to accompany existing constructs of construction marketing frameworks. The result of the amalgamation will be a construction marketing framework that is capable of achieving holistic and comprehensive examination of construction marketing issues. The construct combines human behavior, growth orientation and behavior in an integrated fashion to achieve its objectives. Construction marketing and management researchers will find this framework useful for investigating marketing related issues in the construction industry by providing a new direction to construction marketing research.

Keywords
Construction Marketing, Construction Education, Framework, Human Factors, Marketing

(Paper, ID 120)

Policies And Plans For Sustaining The Economy In Construction Industry of Pakistan

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Abstract
The construction industry is one of the most important components in the economic development of a developing country, being a major contributor to the national economy of many such countries. In the developing economy of Pakistan, the construction industry is encountered by different economic and technical problems. The recent global shift to sustainable development also requires that the construction industry in Pakistan initiate important strategic developmental policies to meet the future demand for economical and sustainable development. This research uses a comprehensive literature review

to conduct a survey into the existing local development barriers and then obtains a census of expert opinion using the DELPHI methodology to rank a set of sustainable developmental policies and strategies. The results indicate that the main factors affecting the economy and efficiency of the construction process in Pakistan are administrative problems and bureaucracy, inadequate finance system, Inflation and fluctuation of prices, lack of management and planning, excessive wastages and corruption. Strategies and policies for the solution of these problems were then identified and ranked in order of their importance using the Delphi methodology.

Keywords
Delphi methodology, Sustainable Development, Construction Industry

(Paper, ID 121)

Investigation of Relationship between Demographic Factors and Construction Safety Climate

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Abstract
The construction industry plays an important role in the economic and social development of the world. The construction company deals with the construction projects executed by the number of workers thus the safety of these workers should be investigated and provided properly. In the developed and developing countries the safety in the construction industry is considered a major issue. In Pakistan many construction companies are working on different projects but the safety and health facilities provided to the workers by the organizations are not meeting the standards. In this research an attempt is made by using the safety climate questionnaire and demographic factors having several statements with the Likert scale. Survey was conducted on more than thirty six construction projects in different cities of Pakistan. The main objective of this study was obtained by keeping in view the relationship of demographic factors with the safety climate including construction company type, project types, nature of employee, age and educational level of the workers.

Keywords
Safety, Safety Climate, Operation And Maintenance, Mean Safety Climate Score, Demographic Factors

(Paper, ID 122)

Economic Sustainability in the Construction Industry of Pakistan

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Abstract
The construction industry is one of the most important components in the economic development of a developing country, considered as the backbone of prosperous economies providing social development and employment. In the developing economy of Pakistan the construction industry is encountered by different economic and technical problems. Macroeconomic problems in unemployment and inflation add to the existing economic situation in the construction industry. Other major contributors are the lack of appropriate infrastructure, weak and inefficient legal, administrative and financial institutions. This research uses a comprehensive literature review to conduct a survey into the existing local development barriers and indicates that the main factors affecting the economy and efficiency of the construction process in Pakistan are administrative problems and bureaucracy, inadequate finance system, inflation and

fluctuation of prices, lack of management and planning, excessive wastages and corruption. In the developing country the construction industry appears aligned to the need and it is expected that the findings of this research will be of great interest to the professionals involved in the construction economy.

Keywords
Sustainability, Sustainable development, Economic development, Construction economies

(Paper, ID 123)

Revolutionizing the AEC Industry Through the Use of BIM and KM

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Abstract
Building Information Modeling (BIM) is deemed to be one of the prominent tools of the 21st century in the Architecture, Engineering and Construction (AEC) Industry, helping construction stakeholders, and clients to gain value from their projects. Moreover, information and lessons learned during a construction project, i.e. what can be called "project knowledge", face some kind of leakage during the design and construction phases. In other words, knowledge provided by some stakeholders, such as Tier 2 sub-contractors, is unexploited; hence the value of the project diminishes. For this reason, BIM is integrated within the project to be able to exploit that knowledge before its loss, and retain its value within the project. This paper will discuss the design and information tools before the advent of BIM followed by the multiple definitions and concepts of knowledge management (KM) in construction projects. Then it will present an overview of the possibilities for the use of BIM in managing knowledge in construction projects.

Keywords
Building information modeling (BIM), Knowledge management (KM), Technology

(Paper, ID 124)

Measurement Models Evaluation of Performance Measurement and Improvement Framework for Small and Medium Sized Constructors in Developing Countries - A Jordanian Case

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Abstract
Underperformance by Jordanian contractors is a major cause of concern amongst stakeholders in Jordan. There is broad agreement between the stakeholders of the Jordanian construction industry that the lack of a performance measurement tool for Jordanian contractors is a major cause of poor project delivery. The construction industry of Jordan is dominated by small and medium- sized (SM) contractors, who face unique challenges in the implementation of projects. This paper presents the development of a contingency- based performance measurement and improvement framework for SM sized construction contractors. Using a stratified sample of 200 Jordanian construction contractor firms, the research framework's reflective measurement models were evaluated by using the construct validation process (the classical validation approach by using the SPSS software and the contemporary validation approach by using partial least squares structural equation modeling technique (PLS-SEM)). On the other hand, the recommended approach for evaluating the formative measurement model was adopted. Overall, 46 out of 103 measurement items were removed with an aim to improve the constructs' reliability and validity. In particular, the results show that the project performance results - as a second (higher) order construct- can be measured by six lower order constructs. In addition, the results show that the contractor's overall business performance is characterized by the profitability and customer satisfaction. On the other hand, internal contingencies/enablers were characterized by four constructs; contractor's technical capabilities, resources and processes, contractor's leadership, contractor's management capabilities, and contractor's human resources management. Further the results revealed that the stakeholders' performance characterized by three constructs; consultant, client, and supplier performance. Finally, the results show that external attributes can be characterized by the task and institutional environment. The results of this research can be used to inform managers and owners of the contracting firms of the most significant internal and external contingencies that impact on their performance. Consequently, appropriate strategies can be established for enhancing performance outcomes and competitiveness. Further, those measurements can be used by the clients and the consultants in their contractors' pre-qualification and selection criteria processes, which help in identifying the competitive contractors with superior performance.

Keywords
Contingency, Contractors, Performance, Task and Institutional Environment, Developing Countries

(Paper, ID 125)

BIM and People Issues: Exploring Implications for Curriculum Design

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Abstract
Government sponsored reports have highlighted the need for improvements in people skills for those working in the UK construction industry. The mandating of Building Information Modelling on government projects by 2016 (Government Construction Strategy 2011) highlight these issues and bring their own specific challenges. It is in the construction organisation's interest that they have to innovate and adopt BIM. However evidence suggest that innovation is always met with resistance in organisations. One of the reasons for resistance is the expectation that innovation brings about the need for new skills and that some traditional skills become obsolete. The aim of this study was to get a better understanding of the 'people' related challenges when organisations are adopting BIM and particularly focuses on education and training requirements and the extent to which BIM implementation affects the dynamics of people skills. This is particularly crucial considering that some of the key features of BIM implementation (such as coordination, collaboration and communication) are people related issues.The research places the discussion within a quantity surveying professional practice context to see how representative organisations are addressing some of these challenges. A review of literature suggests that the adoption of BIM is relatively slow in UK quantity surveying organisations but does not find any evidence of resistance to adopting BIM as a management process or a set of digital technologies. The findings in the paper are based on interviews with industry practitioners and questionnaire survey data collection. The findings are of relevance to both industry and academia. In particular, as BIM curricula develops, consideration needs to be taken of people skills.

Keywords
BIM Implementation, People skills, innovation, BIM curriculum

(Paper, ID 126)

Developing A Data Gathering Tool For Modeling Uncertainty In Highway Projects

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Abstract
This paper examines the different sources of uncertainties encountered in the construction process of highway projects and its effect on cost and time underestimation towards developing a data gathering tool for modeling uncertainty. The rationale for this examination stems from the view held by scholars that construction of highway projects are often beset by cost overruns and time delays and the lack of appropriate tools and techniques for use in gathering data for modeling uncertainty in the construction process. A review of extant literature in the area of construction estimation and risk management is undertaken to guide the direction of the study. It emerged from the review that there are three sources of uncertainty in the construction process of highway projects namely: variability in the construction process of highway projects, correlations between highway activities costs and times, and disruptive events were identified through analysis. Also, it was found that uncertainties encountered in the construction process of highways impact on cost and time, through a combination of the risk events of individual construction activities. A data gathering tool for modeling uncertainty in the construction process of highway projects is developed using these three sources of uncertainty and the quantitative model of variability by employing probability distribution. This tool will be used in a future research for data gathering of the uncertain events of individual construction activities in highway projects.

Keywords
Correlation, Disruptive event, Uncertainty, Underestimation, Variability

(Paper, ID 130)

An Exponential Model for Manpower Planning in the Australian Construction Industry

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Abstract
This study presents a critical review of methods and tools used for predicting manpower demand within the Australian construction industry. Between 2001 and 2015, only two out of the 20 sectors reported by the Australian Bureau of Statistics have contributed a little more than construction in terms of sectoral GDP

and real growths. Heading to the future: Australia has had an ambitious infrastructure plan. There is commitment to build bigger and better infrastructure and to repair loads of existing stock. These require highly skilled workforce in the appropriate grade and number. Australia has had to rely on construction skill imports to this day! A small rise in construction and infrastructure spending would mean that more workers are needed in the construction sector. Even if the spending remains unchanged from previous years', the construction sector has had a significant proportion of aged, and ageing, workforce that requires replacement at now or at some stage. First, this study will explore the appropriate number of construction workers needed to maintain consistent growth within the Australian construction industry in the next 15 years. Historical data from the Australian Bureau of Statistics were analyzed. A polynomial model is developed. One percent rise in Construction GDP will require *y* number of workers, predicted by $-0.0000008x^2 + 0.0182x - 181.06$ ($R^2 = 0.938$; R=0.968); where *x* is Seasonally Adjusted Construction GDP (in AUD). Findings will help policy makers and researchers on how to deal with labor issues in the industry.

Keywords
Australia, construction GDP, infrastructure, manpower planning, policy

(Paper, ID 135)

Competency or Competence: Let's talk

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Abstract
One of the most significant challenges facing a business today is to stay relevant and competitive in an ever-changing market. To be successful in the turbulence and disruptions of a competitive market place organizations must also be successful in their projects. This puts the onus on the project managers to deliver the value through successful projects. In the intervening years there has been a dramatic growth in the number of businesses employing project management as an important tool in achieving business outcomes or gaining a competitive advantage. Unfortunately, the overall success rate of projects is still very poor as evidenced by the Chaos reports. This may be attributed to the selection of project managers who are a wrong fit for a certain type of project. There is growing recognition of the fact that hard skills such as technical or domain expertise may be essential in managing a project, it is the soft skills such as tacit knowledge of the organizational culture and clients that provide the most important contribution that a project manager brings to a project. The selection of a skilled project manager with recognized leadership competencies is becoming a critical determinant in the success of a project. To cater for this, industry organizations such as Project Management Institute (PMI) has developed the Project Management Competency Development Framework (PMCDF). The further development in this area has created confusion between competence and competency. The aim of the paper is to add to the discussion and help understand the nature of confusion between the two terminologies.

Keywords
Project Management, Competence, Competency, Competency Models

(Paper, ID 136)

Life Cycle Cost Analysis of a Green Home: A Case Study

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Abstract
Due to an increasing consumption and depletion of energy sources, the US government has formulated various policies for reducing electricity and natural gas consumption. These policies help not only to reduce the energy consumption but also help to reduce greenhouse gas emissions. In addition to this, home designers, homebuilders, and homeowners need to be aware of homeowner practices that affect the energy consumption of residential buildings. Some of these are; use of energy efficient appliances, energy efficient home designs and remodels that use good ventilation and insulation, and use of solar-powered appliances. This research study explored the cost benefit of manufacturing green homes through a case study. Data for this study was gathered from Picerne Military housing. Picerne Military housing constructs and maintains military housing at Ft. Rucker Army Airfield in Daleville Alabama. By using LEED for Green home building standard Picerne has been able to reduce the energy use in the military housing by 15% since taking over management and construction from the military. All of Picerne's housing is built to the LEEDs silver standard. There is a positive cost benefit to building

homes to green standard if the builder uses technology that is not so new that the cost overcomes the energy savings. The researcher concluded that building a green home is a positive cost benefit to a potential home-builder. The operation and maintenance cost of the home will be reduced for the homeowner as long as the home designer does not over do the green aspects of the home.

Keywords
Green Homes, Cost/Benefit analysis, Energy Use

(Paper, ID 137)

Sustainable Concrete Construction using Pulverised Fly Ash as a partial replacement of Portland Cement

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Abstract
The use of Binary Cement concrete incorporating Supplementary Cementitious Material (SCM) has been increased to reduce the cement consumption in construction industry. The cement production is the major source for the generation of Green House Gases (GHG) and there is an increasing pressure to reduce its consumption to avoid further Global Warming, Climate Changes etc. In this research, Pulverised Fly Ash was used as a partial replacement to cement in concrete. The Portland cement was partially replaced by PFA in three different percentages and was cured in sealed bags at room temperature of 20 oC to minimise the loss of moisture. Due to low early age strength gain of concrete containing GGBS and PFA, their use in the fast track construction and post tensioned concrete where they are exposed to high early age loads is limited. To overcome this problem, the water/cement ratio of the concrete produced was kept low to achieve higher early age and ultimate strength which also adds to the durability properties of concrete. To achieve the maximum workability, superplasticiser was used. The strength development characteristics of the blended concrete has been compared with control mix having no PFA The compressive strengths of blended concrete for various levels of cement replacement has been observed as nearly the same as the control concrete mix.

(Paper, ID 138)

A Trade-based Risk Management Approach towards the Elimination of Defects in Residential Construction

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Abstract
The construction industry seems to have settled down to a level of inefficiency saddled with a culture of handing over buildings with defects with mechanisms for dealing with patent, latent, serial and other defects. While it is important to understand direct and root causes of defects, the key to success lies in implementing strategic solutions in an environment where subcontracting is rampant: Accordingly, this study takes a trade-based risk management approach to identify problematic trades by undertaking a risk assessment. While Queensland Building Construction Commission's top ten defects provide an indication of what such trades may be, this study argues that it fails to provide a comprehensive overview of the defects regime related to single and two-storey houses, therefore, this study focuses on all 34 trades that requires a license to practice. Trades that are *high risk*, *moderately high risk*, and *moderately risky* have been identified through an on-line questionnaire survey sent to approximately 500 respondents which seek information on the *likelihood* and the *impact* of defects for each licensed trade including reasons for high risks. The scores received are translated to risk levels and multiplied together to arrive an overall risk score which is classified into *high, moderate,* and *low risk* using a risk classification matrix. Accordingly, 14 problematic trades have been identified with Waterproofing being the riskiest trade followed by Swimming Pool Construction and Concreting. The study emphasises the value of this approach to practitioners and regulators to develop strategies for ensuring buildings are defect free.

Keywords
Defects, risk, trade, root causes, management and regulatory strategies

(Paper, ID 139)

A Proposal for Low Cost Energy Efficient Public Housing Scheme in Pakistan

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Abstract
The rapidly growing world energy usage has raised concerns over supply difficulties, depletion of energy resources and heavy environmental impact. It is estimated that the energy consumption of buildings is between 35%-40% of the total energy production. Moreover, growth in population, increasing demand for building services and comfort levels, together

with the rising amount of time typically spent by humans inside the buildings, assure that upward trend in energy demand will continue in the future. Therefore, there is a need to find out more energy efficient and cost saving alternatives so as to maintain urbanization of houses at a price affordable to people. This paper presents a proposal for a low cost energy efficient public housing society in Pakistan. The housing scheme called *Ashiana Housing Scheme* (AHS) with a strict control over cost, which allows the low income groups to enjoy livability deriving from energy and cost saving technology. In this research the building components focused for imparting energy efficiency are building's walls. The study includes introduction of Rat trap bond for building masonry walls of homes and illustrates how this construction technique improves energy efficiency and reduces overall cost of the building.

Keywords
Energy efficiency, Low cost housing, Rat trap bond, Public housing, Masonary construction

(Paper, ID 140)

A Comparative Analysis of Typical Pakistani Homes for Energy Consumption - With and Without Courtyards

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Abstract
A major portion of world's energy is being consumed by buildings (roughly 35%-40%), out of which a large amount is utilized by the air conditioning equipment. Current Pakistani home designs do not factor in local climatic conditions as much as they should be to enhance the thermal comfort and conserve energy. Passive cooling techniques such as "Courtyards" can be incorporated into existing designs to decrease the thermal loads. This research compared energy efficiency by adding a standardized courtyard into a typical residential unit of two housing societies of Lahore, Pakistan. The background and importance of courtyard in a residential unit are discussed in the paper. Necessary data collection related to climatic conditions of Lahore and residential by-laws is conducted. The existing housing units are compared with respect to their thermal performance, ventilation and daylight factor response by using the *Ecotect®* software. The monthly and annual cost savings in electricity bills are analyzed. Finally, the design proposals are generated for residential units with courtyards by strictly following the by-laws of the respective housing societies.

Keywords
Passive Techniques, Courtyards, Energy consumption, Energy efficiency

(Paper, ID 141)

Personalised Study Time Plans and Study Time Management:
A Joint Responsibility of Staff, Students, and University Administrators

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Abstract
There is widespread concern that students at transition (from school to university) face many challenges with time management being one. Accordingly, the authors developed a framework labelled as REST to assist students to achieve study success through study time management; the notion that a course of study was similar to a construction project (as in project management) underpinned its development. Having measured students' abilities using the REST concepts (Success, Scope, Strategy, Sequence, Schedule, Synthesis, Review, and Reflect), *Strategy* was found to be the weakest: A *personalised study time management plan* is fundamental to be *strategic* which is also useful for demystifying *Scope*. Such plans including the REST framework may assist all students to achieve academic success particularly for less conscientious and self-regulated students. Embedding the REST framework in discipline-specific courses and incentivising the process is advocated. Rationalising lecture-timetables by clustering lecture times (as against scattering across a study-week), optimising exam timetables, time audits of study workload, de-concentration of high-intensity assignment submission periods (particularly for first year students) and inducting students on time management may facilitate study time management and study success. Accordingly, the responsibility for assisting students with study time management including the development of *personalised study time management plans* rest not only with students but also with academics and university administrators.

Keywords
Construction Management, Personality Traits, Project Management, Success, Strategy, Time Management

(Paper, ID 142)

Biological Cell Theory based Interventions and the Impact on Quality: The Case of a Tower Project

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Abstract
Inspired by the almost defect-free proliferation of biological cells, authors have explored the notion of 'construction as biological cells' metaphorically to develop new insights on how to manage quality. Three concepts, namely, 'transient cell cycle arrest (TCA)', 'readiness check', and 'embedded design' were used as interventions to manage quality in a large transmission tower project taking a participatory approach with action research method and the participant observer method underpinning the investigation. Three cells which were part of the core activities and had a high potential for problems were selected for application of these concepts. TCA was triggered by non-compliance reports (NCRs) connected with the Excavation cell (all resulting in rework) which lead to the improvement of quality as evidenced by the reduction in a number of subsequent NCRs though raising questions on how, when, and why. The 'readiness checks' worked well with the Concrete Supply cell not reporting any NCRs. The 'embedded design' for the Steel Tower Assembly cell displayed the following features 'prototyping prior to cell propagation, embedding lessons learnt, cell readiness checks and assessments, constant surveillance mechanisms during cell growth, feedback and feedforward loops, and product traceability systems' which resulted in only two NCRs but no TCAs were initiated raising the question whether the first NCR should always lead to a TCA. These issues will be explored further in due course while noting that these interventions may have played a role in keeping rework costs below the threshold level and for the project been declared as the winner of the contractor's national award for project excellence.

Keywords
Biological cell theory, embedded design, transient intervention, quality management

(Paper, ID 143)

Production of Sustainable Concrete Using Class-F Fly as Binary Cementitious Material

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Abstract
Power plants burns huge amount of coal discharging huge sum of fly ash as a scum to the environment. Which leads us to environmental threats in form of waste and hazardous effects. Instead of dumping it to the landfills it has the potential for valuable uses. In this research work feasibility of class-F fly ash is studied and its potential is exploited for the production of sustainable concrete as partial replacement of cement. Four type of concrete mixes containing 5%, 10%, 15% and 20% class-F fly ash as replacement of ordinary Portland cement by weight were prepared and compared with the control mix. These concrete mixes were moist cured and tested at 7, 28 and 90 days to check its compressive and flexural behavior and compared to control mix. Split tensile test on all mixes were performed at 28 and 90 days. Results showed that early age strength of concrete having fly ash is less than strength of concrete without fly ash while later on strength of fly ash concrete increases depicting pozollonic nature of fly ash. Use of fly ash in concrete enhances durability of concrete and reduces the carbon foot prints by reducing use of cement, which is a step towards economical and sustainable construction.

Keywords
Fly ash, Surveillance, sustainability

(Paper, ID 144)

Uses of Augmented Reality Technology during Construction Phase

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Abstract
Widespread implementation of Building Information Modeling (BIM) in the Architecture, Engineering, and Construction (AEC) industry has revolutionized the way professionals design and visualize their projects. BIM can provide design professionals with a 3D model that can encapsulate a structure, and also contains accurate building information within the model. In the last decade, major advances in

augmented reality (AR) technologies have made it possible to bring the 3D models created by a project's designer into the field. The aim of this research is to investigate the benefits and challenges of currently available augmented reality technology for construction uses during a building project, to examine the current technologies used during construction phase as opposed to design phase, and to determine the long range potential for AR technology uses by the building trades. The methodology of this research used interviews with general contractors and technology companies working in the field of augmented reality. The data collected through the interviews was compiled, analyzed, and reported in this paper. The outcome of this research provided insight into a technology that has lots of potential but is still not sufficiently developed and available for widespread implementation on construction jobsites. The interview findings discussed present uses of AR, opportunities and challenges of using augmented reality, and hopes for how the technology could be applied. The main risks of augmented reality are the costs associated with implementation, and the extent that the technology is ready to be used in the field.

Keywords
Augmented Reality, Building Information Modeling, Construction

(Paper, ID 145)

The Role of Organizational Culture in the Lean Construction Transformation

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Abstract
The traditional methods for delivering construction projects have great room for improvement, despite the best intentions, many projects leave the stakeholders dissatisfied with the results, as schedule overruns and budget excesses occur far too often. Studies by the Construction Industry Institute, The McGraw Hill Engineering News Record and the Lean Construction Institute indicate that projects delivered by the lean methodology are likely to save 5 to 10% or more of project cost and to reduce schedules to a similar extent. The adoption of lean requires significant changes in organizational culture. (Izquierdo 2010, Angelo 2010). This paper discusses some of the strategies needed to change organizational culture, making reference to a lean project team that modified its culture. A case study of the expansion of a health care facility identified how the project culture was redirected from the traditional mode to a lean environment within the time frame of a project. A later discussion with construction professionals provided perceptions on the adoption of the lean methodology. The study results underscored the importance of a lean culture in the successful deployment of lean projects, and provided guidelines for improvement.

Keywords
Lean construction, Lean culture, Integrated Project Delivery, Integrated Form of Agreement, Lean transformation, Building Information Modeling

(Paper, ID 146)

Use of Low Resolution Satellite Imagery (LRSI) For Development of Building Inventory

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Abstract
Building or housing inventory plays basic role in the Seismic Risk Analysis (SRA). Housing census and type of building based on its construction type is an important aspect for seismic risk analysis. The housing census of Pakistan was done initially on the basis of population census 1998. The present housing stock has been estimated by extrapolation of the 1998 housing census at the population growth rate. This rationale is not logical as the temporal and spatial variation in the housing stock and extensive urbanization as well transmigration of large populations has complicated the scenario. The southern part of Pakistan (Baluchistan) province is more vulnerable to earthquakes. The non-availability of rational district-wise housing census is a major impediment to developing proactive disaster mitigation plan at district levels. In this research, a quasi-observational method has been used, incorporating the low-resolution satellite imagery of Google Earth and field observations of some selected areas, to develop the district wise housing inventory. It has been observed that almost 85% of the houses are non- engineered houses constructed in mud, unreinforced brick masonry with mud mortar and rubble stone masonry, which are highly vulnerable to earthquake damages and risks. In such areas more proactive disaster mitigation strategies are required.
Keywords: Buildings, Inventory, Seismic Risk Analysis, LRSI, Online Google Earth®, Baluchistan, Pakistan

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- A Special Thank you to our Sponsors -

On behalf of the CITC-9 Organization, we would like to express our gratitude to the Pakistan Business Council Dubai, Schön Properties and Shaikhani Group for their sponsorship.

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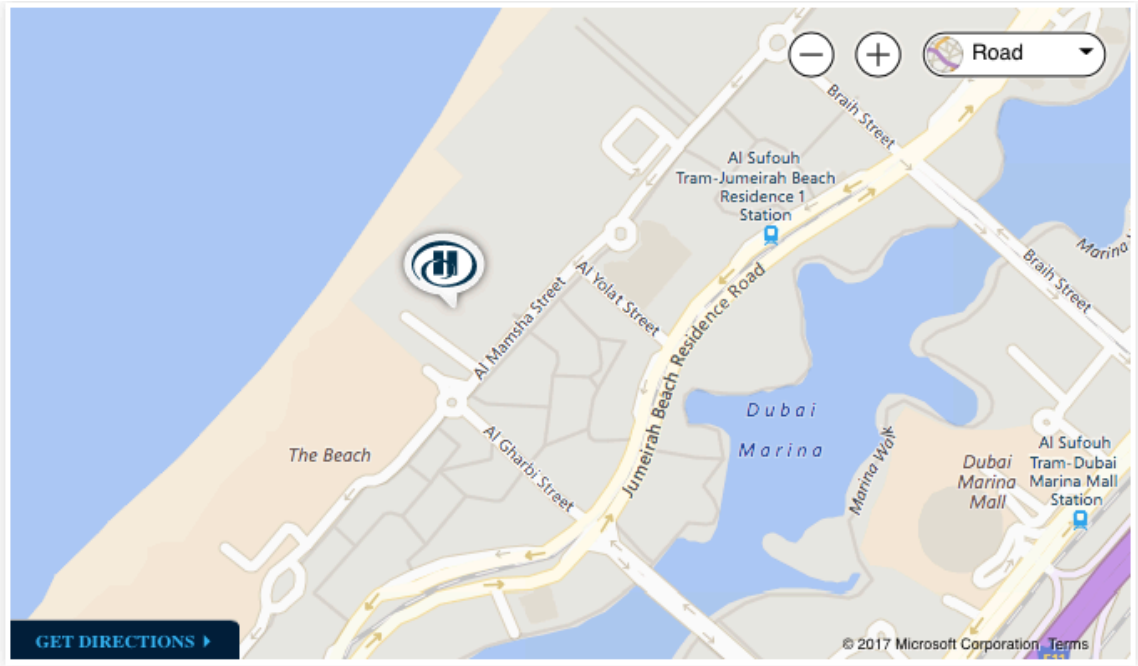
The Pakistan Business Council Dubai, Schön Properties and the Shaikhani Group worked in collaboration with our conference coordinators to organize and fund the desert safari and site visits, key activities that influenced the success of CITC-9

Hotel Information



Map of the CITC-9 Location: Hilton Dubai Jumeirah Resort

Hilton Dubai Jumeirah Resort offers plenty of opportunities for relaxation and entertainment. Unwind in the spa or enjoy the private beach club with a shaded pool. If you're feeling active, visit the contemporary fitness center or browse the local businesses and popular attractions such as Ski Dubai and Wadi Waterpark. Take the afternoon off and enjoy a round of golf at some of the city's finest courses or step outside to The Walk, comprised of more than 300 shops and restaurants.

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Sunday, 5 March 2017

09:30-10:30	Registration (Foyer)
10:30-14:00	Site Visits: Sponsored by the Shaikhani Group and Schon Properties (Meet in Foyer)
14:00-15:00	Registration (Foyer)
15:00-16:30	**Workshop:**
	Workshop Presented by Dr. Mohamed El Agroudy "Project Risk Management in Different Stakeholders' Perspectives" Location: TBA
19:00-21:00	Welcome Reception (Foyer)

Monday, 6 March 2017

08:00-09:00	Registration (Foyer)	
09:00-09:30	Opening Ceremony with CITC-9 Chair, Dr. Syed M. Ahmed (Almas Ballroom)	
9:30-10:00	Keynote Speaker: Khalid El-Rayes (Almas Ballroom)	
10:00-10:15	Morning Coffee/Tea Break (Foyer)	
10:15-11:45	**Session 1A: Almas Ballroom 1**	**Session 1B: Almas Ballroom 2**
	Chair: Esra Bostancioglu	**Chair: Suhair Alkilani**
	(ID 7) Improving Productivity of Road Surfacing operations with the help of Lean and Discrete Event Simulation techniques; a UK case study **Rana Muhammad Qasim**, Dr. Zeeshan Aziz	(ID 130) An Exponential Model for Manpower Planning in the Australian Construction Industry **Oluwole Olatunji**
	(ID 94) Identifying Cost Impacts to Public Storm Water Infrastructure for Campus Development **Kevin Sellers,** Keith A. Rahn, Scott W. Kramer	(ID 55) Key Factors for the Selection of Project Management Consultants Yehya Nattat, **Sameh Monir El-Sayegh**
	(ID 17) Cost of Accidents in Construction in Oman **Tariq Umar**	(ID 58) Towards Automated Process to Manage Buildings' Environmental Sustainability- A BREEAM Application **Tala Kasim**, Mustafa Ali, HaiJiang Li, Yacine Rezgui, Tom Beach
	(ID 95) Exploring Solar Water Heating Systems and Uses at Ft. Stewart, Georgia USA Andrew J. Cox, **Scott W. Kramer**, April Simons,	(ID 59) Systematic Literature Review as a Methodology for Identifying Risks **Rana Khallaf**, Nader Naderpajouh, Makarand Hastak

	(ID 40) The Effect of Curb Appeal on the Property Value of a Single-Family Dwelling **Ifte Choudhury**, Yatin Wadhwani	(ID 41) Key Issues in Procurement and Management of Consulting Engineering Services in Public Sector Organizations **Rafiq Muhammad Choudhry**, Khalil Ahmed bin Mushtaq, Mohammad Umair Saleem
	(ID 124) Measurement Models Evaluation of Performance Measurement and Improvement Framework for Small and Medium Sized Constructors in Developing Countries- A Jordanian Case **Suhair AlKilani**, Benson Lim, Imriyas Kamardeen	(ID 46) 3D BIM Model as a Legal Construction Document **Khalid Siddiqi**, Mauro Prada-Garcia
11:45-13:00	Lunch (Location TBD)	
13:00-13:30	Keynote Speaker: Dr. Abdul Samad Kazi (Almas Ballroom)	
13:30-15:00	**Session 2A: Almas Ballroom 1**	**Session 2B: Almas Ballroom 2**
	Chair: Scott Kramer	**Chair: Kleopatra Petroutsatou**
	(ID 68) Determination of Polymer Content in SBS Modified Asphalt Binder using FTIR Analysis Md Amanul Hasan, Umme Amina Mannan, **Rafiqul A Tarefder**	(ID 28) Applications for Unmanned Aerial Vehicles in Electric Utility Construction **Lonny Simonian**
	(ID 63) Risk Evaluation In The Arabian Gulf Region (Agr) Construction Industry From Multinational Firms' Perceptions **Ruqaya Al-Sabah**, Hala M. Nassereddine, Awad S. Hanna	(ID 105) An Assessment of Soft Factors Leading to Rework and its Impact on Project Performance-The Experience of Pakistani Construction Industry Muhammad Umer, **Rizwan Farooqui**, Muhammad Saqib
	(ID 71) The Awareness and Benefits of BIM in the Construction Industry of Saudi Arabia **Saud Alhumayn**, Ezekiel Chinyio, Issaka Ndekugri	(ID 65) Critical Success Factors for Reduction of Cost of Poor Quality from Construction Projects Shahid Mahmood, Nadeem Ishaq Kureshi, Waqas Farid
	(ID 73) Controlling The Effects Of Organizational Risk On Time And Cost In The Construction Industry In The UAE **Mohammed Hassan Murad**	(ID 108) Building Relocation Case Study in Pakistan **Muhammad Saqib**, Mustafa Shabbir, Rizwan U. Farooqui
	(ID 75) Safety Effects of Roadway Intersection Lighting **Yi Jiang,** Guangyuan Zhao, Shuo Li	(ID 27) Review of Sustainable Design Principles for Leed Certified Buildings: The Case of Turkey **Esra Bostancioglu**, Kubra Celik
	(ID 81) Approach of Cost Monitoring with 5D BIM on Construction Project **Lin Xiaofeng**, Vachara Peansupap	(ID 145) The Role of Organizational Culture in the Lean Construction Transformation **Lincoln Forbes**, Syed Ahmed

15:00-15:15	Afternoon Coffee/Tea Break (Foyer)	
15:15-16:45	**Session 3A: Almas Ballroom 1**	**Session 3B: Almas Ballroom 2**
	Chair: Vasantha Abeysekera	**Chair: Paul Hampton**
	(ID 91) Construction Project Management in Developing Countries: The Case of International Construction Projects In Kenya **Kimani Thomas Njuguna**, Ahmad Omar Alkizim, Mugwima Njuguna	(ID 83) Resource-Constrained Project Scheduling using Evolutionary Algorithms Charalampos P. Sinos, **Athanasios P. Chassiakos**
	(ID 96) Managing Workforce Diversity at Gulf Cooperation Council Construction Sites Ahmed Jalil Al-Bayati, Osama Abudayyeh, Syed M. Ahmed, **Shahad Fadhil Al-Bayati**	(ID 90) Identification of Risk Factors for Wind Energy Investments in Turkey **Emre Caner Akcay**
	(ID 100) Case Studies of Energy Efficiency Housing in South Australia **Tony Ma**, Christy Chan	(ID 86) The Impact on Environment and Decision Making Between Similarity of Design and Materials Difference through BIM Mohammed Sami Mahdi, **Nicolae Postavaru**
	(ID 111) Integration Of Tablets And Smartphones In Construction Projects: Challenges And Solutions **Manuel Silverio**, Suresh Renukappa, Angelines Donastorg, and Subashini Suresh	(ID 23) A qualitative approach to success factors of healthcare construction projects in Iran **Reza Zandi Doulabi , Ehsan Asnaashari**
	(ID 112) An Empirical Study On Training Provision For Knowledge Management In The Kingdom Of Saudi Arabia's Construction Industry **Hanouf Alosaimi**, Suresh Renukappa and Subashini Suresh	(ID 67) Identification of Iran's road construction project risks in order to implement sustainable development **Sepide Motamedpooya. Zahra Ramezani** **Mahmood Golabchi. Ehsan Asnaashari**
	(ID 60) Project Control Using BIM **Pavan Meadati**, Parminder Juneja	(ID 31) Financial Analysis of Greek Construction Enterprises Based on Investment Ratios Chrysi Mpakratsa, Dimitrios Lampakis, **Georgios N. Aretoulis**
	(ID 144) Uses of Augmented Reality Technology during Construction Phase Alex Heinzel, Salman Azhar, **Abid Nadeem**	(ID 47) An Investigation of Using Photogrammetry Technology on 3D Digital Recreation of the Historical Progression of a Historic Building Alex Getz, Junshan Liu Richard Burt, Ph.D., **Wesley Collins**
19:30-22:30	Dinner Cruise (Meet in Foyer)	

Program at a Glance

Sunday, 5 March 2017

09:30-10:30	Registration: Foyer
10:30-14:00	Site Visits
14:00-15:00	Registration: Foyer
15:00-16:30	Workshop: "*Project Risk Management in Different Stakeholders' Perspectives*" Hosted by Mohamed El Agroudy (Location TBA)
19:00-21:00	Welcome Reception: Foyer

Monday, 6 March 2017

08:00-9:00	Registration (Foyer)
09:00–09:30	Opening Ceremony with CITC-9 Chair, Dr. Syed M. Ahmed
09:30-10:00	Keynote Speaker: Dr. Amr Elnashai
10:00-10:15	Morning Coffee/Tea break
10:15-11:45	*Session 1A & 1B*
11:45-13:00	Lunch (Location TBA)
13:00-13:30	Keynote Speaker: Dr. Abdul Samad Kazi
13:30-15:00	Session 2A & 2B
15:00-15:15	Afternoon Coffee/Tea break
15:15-16:45	*Session 3A & 3B*
19:30–22:30	Dinner Cruise

Tuesday, 7 March 2017

08:00-8:30	Registration: Foyer
08:30-09:00	Keynote Speaker: Dr. Albert Chan
09:00-10:30	*Sessions 4A & 4B*
10:30-10:45	Morning Coffee/Tea break
10:45-12:15	*Sessions 5A & 5B*
12:15-13:30	Lunch (Location TBA)
13:30-14:15	Industry Speaker: Hany Ahmed Salah
14:15-15:15	Afternoon Panel & Coffee / Tea: "*Global A/E/C Industry in the Next twenty years: Where are we headed?*" led by Dr. Irtishad Ahmad
16:00-22:00	Desert Safari

Tuesday, 7 March 2017

08:00-08:30	Registration (Foyer)	
08:30-09:00	Keynote Speaker: Dr. Albert Chan (Almas Ballroom)	
09:00-10:30	**Session 4A: Almas Ballroom 1**	**Session 4B: Almas Ballroom 2**
	Chair: Tony Ma	**Chair: Julian Kang**
	(ID 36) A Network Approach to Investigate Coordination in Construction Projects: A Literature Review and Research Directions Mohamed A. El-Gafy, Lingci Meng, **Amine Ghanem**, Kasim A. Korkmaz	(ID 143) Production of Sustainable Concrete Using Class-F Fly as Binary Cementitious Material Shah Room, **Attaullah Shah**, Muhammad Ahmad
	(ID 115) Building Information Model For Infrastructure: Challenges and Benefits **Haddy Jallow**, Suresh Renukappa and Subashini Suresh, Ahmed Alneyadi	(ID 26) The Application of Augmented Reality and Virtual Reality in the Construction Industry Using Wearable Devices Dr. Poorang Piroozfar, **Mr. Amer Essa**, Dr. Eric R. P. Farr
	(ID 15) An Analytical Approach of the Greek Economic Recession on Construction Industry; its Consequences and Future Perspectives of the Sector Kyros Ioannis, **Kleopatra Petroutsatou**	(ID 56) State-Of-Practice of BIM Use for Clash Detection in Pakistan Filza Nadeem, **Dr. Nida Azhar**, Mohsinah Pasha, Nasreen Bint-E-Rizwan, Hiba Arif
	(ID 101) Achieving Project Outcomes for Construction Frameworks **Terence Y M Lam**, Keith S Gale	(ID 52) Utilizing Analytical Hierarchy Process for Contractor Selection in Turkish Public Construction Procurements **Pinar Irlayici Cakmak**, Emre Cakmak
	(ID 43) Using Energy Interventions to Drive Down Energy Consumption: An Occupant Behaviour Case Study **Dr. Paul Hampton,** Pablo A. Perez, Robert Stuart, Neil Young	(ID 20) Integrated BIM-analysis Framework for Plan-irregular Structures Do-Soo Moon, **Amr S. Elnashai**
	(ID 123) Revolutionizing the AEC Industry Through the Use of BIM and KM	(ID 141) Personalised Study Time Plans, and Study Time Management:

	Touria Bouazza Ph.D. Candidate, Prof. David Greenwood	A joint responsibility of staff, students, and university administrators **Vasantha Abeysekera**, Ashoka Abeysekera
10:30-10:45	Morning Coffee/Tea Break (Foyer)	
10:45-12:15	**Session 5A: Almas Ballroom 1**	**Session 5B: Almas Ballroom 2**
	Chair: Keith Rahn	**Chair: Terence Lam**
	(ID 85) Study the Effective Location of Shear Wall and Its Cost of Multi-story Building under Seismic Loading in Iraq Mohammed **Sami Mahdi**, Nicolae Postavaru	(ID 80) Performance of New Generation of Engineered Concrete Materials in Infrastructure Applications **Khandaker M. A. Hossain**
	(ID 136) Life Cycle Cost Analysis of a Green Home: A Case Study Christopher W. Sommer, Salman Azhar Irfan Ulhaq, **Dr. Malik Khalfan**	(ID 92) Evaluation of Causes of Construction Waste in Residential Building Projects: A Case Study of Kolkata **Sutapa Das**, Rimpi Baro
	(ID 135) Competency or Competence: Let's talk **Ken Farnes**, Tayyab Maqsood, Kerry London	(ID 142) Biological Cell Theory based Interventions and the Impact on Quality: The Case of a Tower Project Vasantha Abeysekera, **Mayur Shelke**
	(ID 74) Spall Damage Repair using 3D Printers: Opportunities and Challenges Jaeheum Yeon, **Julian Kang**	(ID 116) Feasibility Study Considerations for Transport Infrastructure Performance: A Desk Study **Chioma Sylvia Okoro**, Innocent Musonda, Justus Ngala Agumba
	(ID 126) Developing A Data Gathering Tool For Modelling Uncertainty In Highway Projects **Alireza Moghayedi**, Abimbola Windapo	(ID 29) Infrastructure Development in Africa: Eradicating Stumbling Blocks to Maximizing Investment Potentials **Innocent Musonda**, Chioma Sylvia Okoro, Erastus Mishengu Mwanaumo
	(ID 12) Challenges Facing Mentees and Mentors in the South African Construction Industry: A Case of Gauteng Region **Ayodeji Oke**, Clinton Aigbavboa, Madidimalo Mutshaeni	(ID 24) Opportunities and Challenges of Women's Roles in Management positions in the Iranian Construction Industry **Azam Karimi Mohammadabadi, Ehsan Asnaashari**
12:15-13:30	Lunch (Location TBD)	
13:30-14:15	Industry Speaker: Hany Ahmed Salah from Trimble	

14:15-15:15	Afternoon Panel & Coffee/Tea: "*Global A/E/C Industry in the Next twenty years: Where are we headed?*" led by Dr. Irtishad Ahmad Panelists: Professor Amr Elnashai, Professor Albert Chan, Dr. Sami Kazi
16:00-19:00	Desert Safari: Sponsored by the Pakistan Business Council, Schon Properties and the Shaikhani Group (Meet in Foyer)

Please note that Presenters are in BOLD