



ASSOCIATION OF RESEARCHERS IN **CONSTRUCTION MANAGEMENT**

TWENTY-EIGHTH ANNUAL CONFERENCE **2012**

September 3-5

Our Dynamic Earth, Edinburgh, Scotland

Programme and Abstracts

Conference and Programme Sponsored by



ARCOM 2012 – PROGRAMME OVERVIEW

Day 1: Monday 3 September					
Registration					11.00
Lunch					12.00
Welcome & Introductions					12.40
Keynote Address: Professor Janet Druker					13.00
Session 1A	Session 1B	Session 1C	Session 1D	13.45	
Coffee & Tea Break					15.00
Session 2A	Session 2B	Session 2C	Session 2D	15.30	
Session 3A	Session 3B	Session 3C	Session 3D	16.30	
Break: Check in at hotels					17.30
Social Reception: Our Dynamic Earth					18.30 for 18.45
Close					23.00

Day 2: Tuesday 4 September					
Late Registration					08.30
Langford Lecture: Aletha Holborough					09.00
Coffee & Tea Break					09.45
Keynote Address: Don Ward					10.10
Debate: Legacies and Impacts					11.00
Lunch					12.00
Session 4A	Session 4B	Session 4C	Session 4D	12.45	
Session 5A	Session 5B	Session 5C	Session 5D	13.45	
Coffee & Tea Break					14.45
Session 6A	Session 6B	Session 6C	Session 6D	15.15	
ARCOM Annual General Meeting					16.00
Break/Tour					17.00
Conference Dinner					19.00

Day 3: Wednesday 5 September					
Late Registration					08.30
Session 7: Plenary Paper Session: Human Behaviour & Culture					09.00
Session 8A	Session 8B	Session 8C	Session 8D	10.15	
Coffee & Tea Break					11.15
Session 9A	Session 9B	Session 9C	Session 9D	11.45	
Closing Comments & ARCOM 2013 Conference					13.00
Lunch					13.15

MONDAY 3rd SEPTEMBER

From 11.00		REGISTRATION		Dominic Ahiaga-Dagbui & Alison Furber	Stratosphere
12:00	12:40	LUNCH			Stratosphere & Ozone
12:40	13:00	Welcome & Introductions			Biosphere Green
13:00	13:40	Keynote Address “Researchers and research: 2012 in overview”		Professor Janet Druker, Univeristy of Westminster	Biosphere Green
13:40	13:45	Disperse to parallel sessions			
Session 1:		1A: Biosphere Green	1B: Biosphere Blue	1C: Salisbury	1D: Hutton
13:45	15:00	Human Resource Mangement and Skills <i>Chair: Dr Shu-Ling Lu</i>	Inter-organisational Relations and Supply Chain 1 <i>Chair: Dr Robby Soetanto</i>	Research Methods and New Perspectives <i>Chair: Professor Andrew Dainty</i>	Procurement 1 <i>Chair: Dr Milan Radosavljevic</i>
<i>5 papers</i>		How is job satisfaction in Spanish building engineers influenced by training? – <i>Fuentes-del-Burgo and Navarro-Astor</i>	Designing a dynamic network based approach for asset management activities – <i>Volker, Scharpff, de Weerd and Herder</i>	A new research agenda into community-based protest in construction – <i>Teo and Loosemore</i>	Housing association preferred form of partnering – <i>Liguori, Sommerville and Manase</i>
		Job satisfaction of professionals within the Ghanaian construction industry – <i>Yirenskyi-Fianko and Chileshe</i>	Improving supplier relationship management within the aec sector – <i>Pala, Edum-Fotwe, Ruikar, Peters and Doughty</i>	Paradigm interplay to develop a sustainability related knowledge management strategy – <i>Leblanc and Thomson</i>	A process account of construction mediation – <i>Sidoli del Ceno</i>
		The socialisation of outsourced employees in facilities management: A research agenda – <i>Tucker, Ogungbemi and Noor</i>	Role conflict and role ambiguity in construction projects – <i>Kabiri, Hughes and Schweber</i>	Resolving the methodological conundrum: Bolstering the research Achilles heel in South Africa – <i>Emuze and Shakantu</i>	The influence of procurement methods on dispute resolution mechanism choice in construction – <i>Mante, Ndekugri, Ankrah and Hammond</i>
		Improving project performance through worker participation in alliance projects – <i>Vilasini and Neitzert</i>	Learning how to eat an elephant: implementing supply chain management principles – <i>Gosling, Towill and Naim</i>	Modelling the impact of extreme weather events on hospital facilities management using a system dynamics approach – <i>Chow, Loosemore and McDonnell</i>	A preliminary method of classifying collaborative contractual behaviour in higher education construction projects – <i>Crowe and Fortune</i>
		Architects in Spain: A profession under risk – <i>Navarro-Astor and Caven</i>	Influence of the macro-economy on trust in construction supply chain chains – <i>Manu, Ankrah, Chinyio and Proverbs</i>	Contextualising innovation in construction firms in regional areas – <i>Brewer, Gajendran and Le Goff</i>	Understanding post-contract changes in partnering projects: an ethnographic approach – <i>Shipton</i>
15:00	15:30	COFFEE / TEA			Stratosphere & Ozone

MONDAY 3rd SEPTEMBER

Session 2:		2A: Biosphere Green	2B: Biosphere Blue	2C: Salisbury	2D: Hutton
15:30	16:30	Forecasting and Decision Making 1 <i>Chair: Dr Andrew Ross</i>	Offsite Construction <i>Chair: Professor Charles Egbu</i>	Sustainability (Operation & Practice) 1 <i>Chair: Professor Chris Gorse</i>	Project Management 1 <i>Chair: Dr Paul Chan</i>
<i>4 papers</i>		<p>An exploration of theoretical concepts and methods for assessing risk impacts on the variability between contract sum and final account in design and build projects – <i>Larkin, Odeyinka and Eadie</i></p> <p>A system dynamics-based method for demand forecasting in infrastructure projects - A case of PPP projects – <i>Alasad, Motawa and Ogunlana</i></p> <p>Neural networks for modelling the final target cost of water projects – <i>Ahiaga-Dagbui and Smith</i></p> <p>Decision-making in façade selection for multi-storey buildings – <i>Garmston, Pan and de Wilde</i></p>	<p>Interface management from an offsite construction perspective – <i>McCarney and Gibb</i></p> <p>Barriers and drivers for increased use of off-site bridge construction in Sweden – <i>Larsson and Simonsson</i></p> <p>Re-engineering the construction supply chain: Transferring on-site activity, off-site – <i>Tennant, McCarney and Tong</i></p> <p>Identification and reduction of non-value adding activities in the precast concrete construction projects in Singapore – <i>Wu, Feng and Zhong</i></p>	<p>Investment appraisal tools and sustainability evaluation in social housing – <i>Higham and Fortune</i></p> <p>The domestication and use of low and zero carbon technologies in new homes – <i>Lees and Sexton</i></p> <p>Lowering CO₂ emissions in the new build social housing sector: A Spanish case study – <i>Downey</i></p> <p>Integrating responsible sourcing in the construction supply chain – <i>Upstill-Goddard, Glass, Dainty and Nicholson</i></p>	<p>Attaining zero defects within Building Schools for the Future: a realistic target or a Sisyphean task? – <i>Boothman, Higham and Horsfall</i></p> <p>The role of problem solving in construction management practices - <i>Schultz</i></p> <p>House building service quality and buyer expectations – <i>Sommerville, Craig and Callaghan</i></p> <p>Re- conceptualising agile for lean construction: The case for “agilean” project management – <i>Demir, Bryde, Fearon and Ochieng</i></p>

MONDAY 3rd SEPTEMBER

Session 3		3A: Biosphere Green	3B: Biosphere Blue	3C: Salisbury	3D: Hutton	
16:30	17:30	Sustainability (Theory & Design) 1 <i>Chair: Professor David Proverbs</i>	Equality and Diversity 1 <i>Chair: Dr Ani Raiden</i>	Health & Safety and Respect for People (Practice & Regulation) 1 <i>Chair: Professor Sam Wamuziri</i>	Forecasting and Decision Making 2 <i>Chair: Dr Simon Smith</i>	
3/4 papers		Delivering sustainable buildings in retail construction – <i>Dangana, Pan and Goodhew</i>	Women at top level management at contractors in Denmark and Norway – <i>Buser and Koch</i>	Safety impacts of alcohol and other drugs in construction: development of an industry policy and cultural change management program – <i>Biggs and Williamson</i>	Forecasting the number of jobs created through construction – <i>Forbes, El-Haram, Horner and Lilley</i>	
		A multidisciplinary literature review of low and zero carbon technologies into new housing – <i>Bevan and Lu</i>	Gender inequality in the construction industry: Lessons from Pierre Bourdieu – <i>Sang and Powell</i>	Evaluating the role and effectiveness of training interventions in improving the occupational health and safety of younger construction workers: A literature review – <i>Nyateka, Dainty, Gibb and Bust</i>	Time series analysis for the prediction of RC material components prices in Egypt – <i>Bassioni, Elmasry, Ragheb and Youssef</i>	
		Delivering zero carbon homes in the UK – <i>Heffernan, Pan and Liang</i>	An assessment of occupants' expectation in the delivery of low-income housing in South Africa – <i>Aigbavboa and Thwala</i>	The principal contractor's role under construction (Design and Management) Regulations 2007: Areas for further research based on a qualitative inquiry – <i>Mzyece, Ndekugri, Ankrah and Hammond</i>	Forecasting capability of a construction organisation model: 10 years later – <i>Tang, Lim and Gan</i>	
		Key criteria of sustainable hospital refurbishment: A stakeholder review – <i>Wilson and Kishk</i>			Comparison of the Grey Model and the Box Jenkins Model in forecasting manpower in the UK construction industry - <i>Ho</i>	
17:30	18:30	<i>Break: Check-in at hotels</i>				Hotels
18:30	18:45	Return to Dynamic Earth				
18:50	23:00	Social Reception: Our Dynamic Earth				

TUESDAY 4th SEPTEMBER

08:30	09:00	Registration	Dominic Ahiaga-Dagbui & Alison Furber		Stratosphere
09:00	09:45	Langford Lecture	Aletha Holborough		Biosphere Green
09:45	10:10	COFFEE / TEA	Stratosphere & Ozone		
10:10	10:55	Keynote Address: "Industry and academia working collaboratively: the benefits and challenges"	Don Ward, Chief Executive, Constructing Excellence		Biosphere Green
11:00	12:00	Debate	Legacies & Impacts		Biosphere Green
12:00	12:45	LUNCH	Stratosphere & Ozone		
Session 4		4A: Biosphere Green	4B: Biosphere Blue	4C: Salisbury	4D: Hutton
12:45	13:45	Sustainability (Operation & Practice) 2 <i>Chair: Professor David Proverbs</i>	Health & Safety and Respect for People (Behaviour) <i>Chair: Dr Simon Smith</i>	Risk Management <i>Chair: Dr Milan Radosavljevic</i>	Organisational Strategy and Business Performance 1 <i>Chair: Dr Chris Harty</i>
<i>4 papers</i>		Evaluating factors in sustainable road construction and management – a life cycle approach – <i>Thorpe</i> Environmental assessment tools and efficiency in housing and office refurbishment – <i>Sezer</i> Factors of sustainability in building design: Establishing their relative significance – <i>Quigley, Heaney and Odeyinka</i> Early stage evaluation of the socio-economic benefits of built environment housing regeneration projects – <i>Akotia and Fortune</i>	Inconsistent, incomplete and incidental: Site safety culture from a constructionist perspective – <i>Sherratt, Farrell and Noble</i> A framework for enhancing and improving the safety culture on Saudi construction sites – <i>Alasamri, Crisp and Bowles</i> Cultural interpretation of health and safety and its appropriateness in the United Arab Emirates – <i>Borthwick and McAndrew</i> Exploring human error through the safety talk of utilities distribution operatives – <i>Patel, Sherratt and Farrell</i>	Reviewing risk allocation for infrastructure PFI: between theory and practice – <i>Issa, Emsley and Kirkham</i> Perceptions of fuzzy set theory in construction risk analysis – <i>Tokede and Wamuziri</i> An examination of the risk management process in Venezuelan construction projects – <i>Calzadilla, Awinda and Parkin</i> Incorporating security measures into the built environment – <i>Harre-Young, Boshier, Dainty and Glass</i>	Corporate entrepreneurship for contracting companies: The current issues – <i>Setiawan, Erdogan and Ogunlana</i> Managing the performing paradox in architectural competitions – <i>Manzoni, Morris and Smyth</i> Managing change through participation: Developing shared construction guidelines in 26 public organisations – <i>Baldursdóttir</i> Towards the identification of factors affecting the development of small sized construction contacting organisations – <i>Ozols and Fortune</i>

TUESDAY 4th SEPTEMBER

Session 5		5A: Biosphere Green	5B: Biosphere Blue	5C: Salisbury	5D: Hutton
13:45	14:45	Project Management 2 <i>Chair: Dr Stephen Gruneberg</i>	Organisational Strategy and Business Performance 2 <i>Chair: Professor David Boyd</i>	Sustainability (Operation & Practice) 3 <i>Chair: Professor Charles Egbu</i>	Education and Learning 1 <i>Chair: Dr Shu-Ling Lu</i>
<i>4 papers</i>		Adaption of structured analysis design techniques methodology for construction project planning – <i>Agyekum-Mensah, Knight and Pasquire</i>	Value management in infrastructure projects in Western Australia: techniques and staging – <i>Whyte and Cammarano</i>	Building refurbishment: Holistic evaluation of barriers and opportunities – <i>Babangida, Olubodun and Kangwa</i>	Workshops as embryonic boundary objects for collaborative university-industry innovation in construction – <i>Stokes, Carillo and Dainty</i>
		An investigation of the factors influencing the success of construction planning for the 2012 Olympic stadium: An ethnographic study – <i>Subbiah</i>	The actors and their roles in the meaning making process of an energy target – <i>Ludvig and Stenberg</i>	A critical review of the concept of facilities management in community-based contexts – <i>Tammo and Nelson</i>	A study on new construction techniques and skills training with focus on the plastering subcontractor in Japan – <i>Mihara, Yoshida, Suzuki and Hojo</i>
		A genetic algorithm for resource leveling of construction projects – <i>Iranagh and Sonmez</i>	A critical review of PMS in construction: Towards a research agenda – <i>Deng, Smyth and Anvuur</i>	Optimising the role of Facilities Management (FM) in the Development Process (DP): The development of FM-DP integration framework for sustainable property development – <i>Tucker, Anang Masuri and Mohd Noor</i>	Framework for formative assessment learning strategies in built environment higher education programmes – <i>Scott and Fortune</i>
		Current practice of variation order management in the Saudi construction industry – <i>Alsuliman, Bowles and Chen</i>	Pro-innovation bias in construction-enablers and risks – <i>Loosemore and Holliday</i>	Green building challenges: evaluating the operation of adopted building assessment tools - case study – <i>Mpakati, Wamuziri and Sloan</i>	Communication modes and performance of virtual design teams in an undergraduate building project – <i>Soetanto, Poh, Austin, Hao and Katsanis</i>
14:45	15:15	COFFEE / TEA			Stratosphere & Ozone

TUESDAY 4th SEPTEMBER

Session 6		6A: Biosphere Green	6B: Biosphere Blue	6C: Salisbury	6D: Hutton
15:15	16:00	Sustainability (Operation & Practice) 4 - Take-up <i>Chair: Dr Andrew Ross</i>	Human Behaviour & Culture 1 <i>Chair: Professor Will Hughes</i>	Equality and Diversity 2 <i>Chair: Dr Paul Chan</i>	Health & Safety and Respet for People (Practice & Regulation) 2 <i>Chair: Professor Andrew Dainty</i>
<i>3 papers</i>		Variations in the mainstreaming of sustainability: a case study approach – <i>Boyd and Schweber</i> Investigating a suitable learning environment to advance sustainable practices among micro construction enterprises – <i>Gleeson and Thomson</i> Detailed design ethnography: architects embedding low carbon performance - <i>Poveda</i>	IDEA contribution in construction: In search for evidence of the interface between idea generation and its implementation – <i>Sergeeva and Radosavljevic</i> A case study of the impact of cultural differences during a construction project in Ghana – <i>Furber, Smith and Crapper</i> Culture shock of alliance projects – <i>Reed and Loosemore</i>	Striving for inclusive design in the built environment: Learning strategy adopted by policy implementers at Local Authorities in England – <i>Amakali, Cook and Larsen</i> Juggling work, family... and life in academia: The case of the “new” man – <i>Raiden, Räisänen and Caven</i> Working hours in a large New Zealand construction company – <i>Morrison and Thurnell</i>	The use of experience and situated knowledge in ensuring safety among workers of small construction firms – <i>Aboagye-Nimo, Raiden, Tietze and King</i> A review of compliance with health and safety regulations and economic performance in small and medium construction enterprises - <i>Arewa and Farrell</i> Determinants of construction firms’ compliance with health and safety regulations in South Africa – <i>Windapo and Oladapo</i>
	16:00	17:00	ARCOM Annual General Meeting Biosphere Green		
17:00	18:00	BREAK (Please note: due to a separate event, all delegates must vacate Stratosphere by 17:00)			
18:00	19:00	BUS TOUR: Depart in front of Dynamic Earth at 18:00 prompt; tour of Edinburgh; arrive Old College 19:00			
19:00	23:00	CONFERENCE DINNER: Reception from 19:00 Raeburn Room; Dinner from 19:45 Playfair Library			University of Edinburgh, Old College
23:00		Close			

WEDNESDAY 8th SEPTEMBER

08:30	09:00	Late Registration	Dominic Ahiaga-Dagbui & Alison Furber		Stratosphere
		<i>Please remember to check out of hotels</i>			
09:00	10:15	Session 7: Plenary Paper Session: Human Behaviour and Culture 2 Chair: Dr Chris Harty Do you feel what I feel? Empowerment contagion in project teams – <i>Tuuli and Acquah</i> The case for slack to promote innovative behaviour in construction firms – <i>Horsthuis, Thomson and Fernie</i> Corruption in the South African construction industry: A mixed methods study – <i>Bowen, Edwards and Cattell</i> Constructing a sense of time in projects: implications of a Bergsonian view of time – <i>Chan</i>			Biosphere Green
Session 8		8A: Biosphere Green	8B: Biosphere Blue	8C: Salisbury	8D: Hutton
10:15	11:15	Building Information Modelling Chair: <i>Professor Chris Gorse</i>	Sustainability (Theory & Design) 2 Chair: <i>Dr Ani Raiden</i>	Education & Learning 2 Chair: <i>Dr Milan Radosavljevic</i>	Disaster Management Chair: <i>Professor Will Hughes</i>
4 papers		Awareness, usage and benefits of Building Information Modelling (BIM) adoption – the case of the South Australian construction organisations – <i>Newton and Chileshe</i>	Thermal performance of buildings and the management process – <i>Gorse, Stafford, Shenton, Johnston, Sutton and Farmer</i>	Developing an understanding of research principles to support post-graduate education in the built environment – <i>Scott and Shaurette</i>	Hospital facility resilience: an adaptation framework for extreme weather events – <i>Chand and Loosemore</i>
		Exploring CAVE: Using immersive environments for design work – <i>Maftai and Harty</i>	A conceptual model for user-centred passive building design – <i>Alzaed and Boussabaine</i>	Effectiveness of the construction management courses – <i>McArdle, Gunning and Spillane</i>	Stakeholders' approaches towards natural disasters in built environment: A theoretical framework – <i>Mojtahedi and Oo.</i>
		BIM implementation plans: A comparative analysis – <i>Ahmad, Demian and Price</i>	Optimizing embodied energy of building construction through bioclimatic principles – <i>Sattary and Thorpe</i>	The integration of diplomats and graduates into the construction industry: A pilot South African study – <i>Smallwood and Emuze</i>	Identifying the added-value of various roles in the post-disaster response and recovery of Christchurch – <i>Kestle and Potangaroa</i>
		Control, surveillance and the 'dark side' of BIM – <i>Davies and Harty</i>	Diagrammatic representations of sustainability – A review and synthesis – <i>Moir and Carter</i>	Curriculum innovation in transnational teaching: A pilot study – <i>Iyer-Raniga and Wingrove</i>	Building capability for disaster resilience – <i>Crawford, Langston and Bajracharya</i>

WEDNESDAY 8th SEPTEMBER

11:15	11:45	COFFEE / TEA				Stratosphere & Ozone
Session 9		9A: Biosphere Green	9B: Biosphere Blue	9C: Salisbury	9D: Hutton	
11:45	13:00	Construction Design & Technology <i>Chair: Professor Charles Egbu</i>	Interorganisational Relations and Supply Chain 2 <i>Chair: Professor David Boyd</i>	Procurement 2 <i>Chair: Dr Stephen Gruneberg</i>	Project Performance <i>Chair: Dr Robby Soetanto</i>	
5 papers		Industrialised Building System (IBS) in Malaysian housing: An emerging innovation system explanation – <i>Sazalli, Greenwood, Morton and Agnew</i>	A conceptual model for construction supply chain management implementation – <i>Aloini, Dulmin, Mininno and Ponticelli</i>	Probabilistic pre-requisites contributing to successful housing association partnering – <i>Liguori, Sommerville and Manase</i>	Evaluation of key metrics for measurement of project performance – <i>Alsulamy, Wamuziri and Taylor</i>	
		Exploring Process, Productivity and Structure in Design – <i>Shah, Tang and Hughes</i>	Collaborative supply chain practices during severe economic downturn in the Republic of Ireland – <i>Taggart, Koskela and Rooke</i>	Impact of the Public Procurement Reform on public building projects delivery in Nigeria – <i>Shwarka and Anigbogou</i>	Evaluating political aspects of success for PPP/PFI sports hall in Croatia – <i>Kušljčić and Marenjak</i>	
		Beyond Scoring: Advancing a new approach to the design evaluation of NHS buildings – <i>O’Keeffe, Thomson and Dainty</i>	Pre-selection of construction consultants based on attributes of trust – <i>McClements, Odeyinka and Eadie</i>	Understanding Early Contractor Involvement (ECI) procurement forms – <i>Walker and Lloyd-Walker</i>	Improving project performance of PPP/PFI project-based organisations – <i>Ndoni and Elhag</i>	
		The roles of representations in building design: materiality and visualisation – <i>Harty and Tryggestad</i>	Knowledge transfer within and across organizational boundaries -A Case Study in the Construction Industry – <i>Berg, Legnerot, Lindström, Nilsson, Bosch and Gluch</i>	Multinational contracting Into Australia: Developing Dunning’s Theory and case study design – <i>Rahman, Bridge, Rowlinson and Kwok</i>	Delivery of complex construction multi-projects in contractor-led procurement – <i>Hagan, Bower and Smith</i>	
		Standardisation of specification driven buildings with serial and repeat order designs – <i>Robinson, Gibb and Austin</i>	Trust, control and knowledge integration in a rock tunnel project – <i>Eriksson and Kadefors</i>	How to proportion capability and fee percentage for team comparison in competitive early involvement – <i>Lahdenperä</i>	Glitches, snags and crises: A study of change in hospital adaptation projects – <i>Garthwaite and Eckert</i>	
	13:00	13:15	Closing comments and Looking ahead to ARCOM 29 th Annual Conference, Reading, 2013			
13:15		LUNCH				Stratosphere & Ozone

FOREWORD

Welcome to Edinburgh for the 28th edition of the Association of Researchers in Construction Management's annual conference. This year's conference promises to be one of the biggest yet, and returns to Scotland's capital for the second time, having first been hosted by Heriot-Watt University in 2004; and to Scotland for the third time after Glasgow in 2000.

This year's conference call attracted a huge amount of interest. 329 abstracts were submitted in February, which resulted in 181 full papers. This has been further reduced to 134 final accepted papers, all of which appear in full in these proceedings. This is one of the highest number of papers that an ARCOM conference has seen and is testament to the popularity, quality and importance of this annual showcase of the best research in international construction management research, particularly at a time of financial difficulty for so many delegates. It is possibly also a reflection of the popularity of our host city for 2012. The Scottish capital needs little to persuade us to visit its mix of Georgian and Medieval streets and our location for the conference itself, at the foot of the Salisbury Crags and Arthur's Seat; opposite the Holyrood Parliament and next to the Queen's Park and Holyrood Palace will hopefully inspire enlightened debate!

In recent years ARCOM, and the ARCOM conference, have grown to become an internationally significant institution. The committee has recognised this yet has steadfastly refused to attempt to cash in on this popularity; rather we have tried to increase the quality of the papers presented. Thus we maintain quite strict standards of academic quality and rigour in our review process. This is impossible without the efforts of its Scientific Committee and I must pause to hopefully ensure all delegates are aware of the key role that these 67 people have played in the development and passage of their papers through the review process. It is worth pointing out that a total of 1333 separate reviews were conducted in order that the proceedings appear as they do.

The industry we research is, as ever, facing a great deal of challenges. It has been very hard hit in Europe by the worldwide financial situation with negative growth in the last year in some countries. It is not just construction that has been hit of course, and this downturn is seen in the academic and higher education sectors also. Frustratingly, many academics are unable to fund and thus fully develop the knowledge and understanding in the way they wish to in order to prepare for better times to come. Yet we continue to see progression and changes in the make up of the research presented at our conference. In particular we continue to see a development of understanding of people: the way they behave, the differences in cultures, how they might be treated and protected better and how the diversity of a workforce can be recognised and treated correctly. This must give us hope for the future, that when the world is able to develop its infrastructure and countries that have lain idle for so long can be allowed to grow that its workforce will be better able to deliver. The papers in these proceedings on equality and diversity; on respect for people; on behavioural and cultural differences are a reflection of this and one only needs to look at the table of contents of proceedings from the early '00s to see how trends have changed. These themes have become more prominent.

In recent years the sustainability agenda has rightly affected the way we approach our work and has resulted in a huge increase in research on sustainability theory, low carbon construction, environmental assessment and of energy reduction. The number of papers on sustainability in this year's proceedings is the largest by some margin in comparison to the other themes. 23 papers have been separated out in to two themes: sustainability theory and design issues as well as research on the operation and practice of sustainability implementation. Many works reflect the policy and strategic governmental changes to produce low carbon dwellings and public buildings.

This year we see a new theme on Building Information Modelling and while the large number of abstracts submitted in this area did not, unfortunately, translate to a similar number of accepted final papers, it is clear that there is much work to be done to appreciate the benefits – and uses – of this new technology; and to educate the breadth of the industry on how to exploit and utilise it. I suspect this will be a growing theme for the next few years.

Papers come from a wide variety of sources. This year, over twenty countries are represented with a vast number of papers coming out of PhD and postgraduate research. ARCOM is proud to nurture this talent and it is also very gratifying to see that a large number of experienced academics number among the registered delegates. I am hoping that the long ARCOM tradition of support and encouragement of early career researchers continues in the debate and discussion, in both lecture room and social arenas of this conference.

There are eight paper prizes to be awarded this year. Three are ARCOM's own awards, commemorating past chairs and committee members Rod Howes, Paul Townsend and David Langford. Five awards are funded by our sponsors: CIOB, RICS and publishers Wiley-Blackwell and Taylor & Francis. The late Prof. Dave Langford is also remembered by the Second Annual Langford Lecture, this year delivered by Aletha Holborough from University of Westminster.

It goes without saying that a conference of this nature needs a lot of support and work behind the scenes and a note of thanks must as always go to the main ARCOM committee in addition to the scientific committee mentioned above. Particularly thanks to Paul Chan, Ani Raiden and Stephen Gruneberg for managing our debate and keynote speaker sessions. I'd like to offer thanks and appreciation to Will Hughes for his support and advice on academic, editorial and many other issues. And last but not least a sincere nod to our new Conference Secretary, Dominic Ahiaga-Dagbui whom most of you will already know from his numerous email communications.

Go forward and enjoy. Engage in debate, make new friends, renew old acquaintances, advance and further our field and have a good time doing so!

*Dr Simon D Smith, University of Edinburgh, UK
ARCOM 2012 Conference Editor*

ARCOM COMMITTEE 2011-2012

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BUILDING INFORMATION MODELLING

AWARENESS, USAGE AND BENEFITS OF BUILDING INFORMATION MODELLING (BIM) ADOPTION – THE CASE OF THE SOUTH AUSTRALIAN CONSTRUCTION ORGANISATIONS

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Research has shown that while Building information modelling (BIM) is not a new concept, and that its uptake is becoming an increasingly important factor in the efficiency and international competitiveness of the Australian construction industry (ACI), when compared with other industries, the ACI is often regarded as being slow to implement new ideas and technologies. Furthermore, there are limited studies conducted which seek to assess the current levels of awareness, usage and advocated benefits of BIM among construction organisations, within the context of South Australia. The study is aimed at filling that knowledge gap. The objectives of this study were to: (1) ascertain the current awareness and determine usage rates of BIM adoption; and (2) establish the advocated benefits relating to the adoption of BIM relative to its impact on project outcomes among the stakeholders of the South Australian construction industry. A field study was conducted with a randomly selected sample of twenty-nine construction organisations. Ten BIM benefits were used, and survey response data were collected using structured questionnaires and analysed using mean and ranking analysis. Relative to the awareness and usage, the findings indicate that a significant proportion of respondents have little or no understanding on the concept of BIM and the usage was found to be very low. The results indicated that 'improved constructability', 'improved visualisation', 'improved productivity', and 'reduced clashes' as the highly ranked benefits associated with BIM adoption. The highly ranked major issues surrounding the adopting or use of BIM were 'lack of understanding about BIM', 'education & training costs', 'start-up costs' and 'changing the way firms do business'. The practical implication for Senior Managers within the construction organisations are that; awareness of BIM processes through education and training; both formal and informal process including more information, and provision of expertise within BIM could enhance the levels of adoption.

Keywords: modelling, awareness, construction industry, South Australia

EXPLORING CAVE: USING IMMERSIVE ENVIRONMENTS FOR DESIGN WORK

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Providing complex health and care infrastructure brings with it demanding design requirements. Information Modelling (BIM) is increasingly used as a solution to managing the complexity of the design process, and coupled with collaborative virtual environments, offers the potential to mediate design activities in ways not possible with traditional CAD models and drawings. This paper describes early analysis of the use of virtual environments for performing design. The project being studied is the design of a new hospital in the UK with all patient accommodation in single rooms. There are particular client requirements around the size of the rooms, and the visibility of patients from nursing stations. Models of the single rooms were imported from CAD models into a CAVE – a 1:1 scale 3D immersive environment set up in a UK University lab. The design teams then used the CAVE to review the design against the client requirements. The methodology for the research consists of both direct observation of these review meetings and analysis of video and audio data captured during them. Early analysis is revealing three emerging themes around the practicalities and utility of this immersive technology. The first is around the work done by users to initially orient and familiarise themselves with the technology and virtual space. The second is the way the environment allows things to be noticed about the design which have previously not been identified. The third is the way users shift between their role as designers, and imagined roles as client viewing the model.

Keywords: CAVE, client engagement, design practice, immersive environments.

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CONTROL, SURVEILLANCE AND THE ‘DARK SIDE’ OF BIM

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Various BIM (building information modelling) technologies are increasingly being positioned as a way to improve coordination horizontally across construction disciplines and vertically between design, construction, manufacture and, increasingly, facility management. The arguments for implementing BIM are persuasive, with potentially significant savings in terms of reducing the re-working of information across the supply chain, and reducing the high levels of physical waste generated. They are also now supported by the recent UK government mandate to use BIM on public projects by 2016. But there are other more problematic considerations with the mobilisation of integrated information management systems, especially around issues of control, surveillance and power. Primarily drawing on Foucault inspired studies of information systems use and surveillance in this paper we look at some of these implications for the division of labour and for control during the construction process. We use empirical material from two longitudinal case studies of BIM implementation; a new airport terminal and two large PFI hospitals, both in the UK. We draw out the issues around the potential and limitations of this technology as a method of imposing control across disciplines and down the supply chain. Whether these technological change initiatives are initially intended to be an instrument of leveraging control over other actors is difficult to ascertain, but our empirical evidence shows that negotiations over who has the power to enforce or resist the technology and processes supporting it are fundamental in shaping how implementation plays out.

Keywords: BIM, control, ICT, labour, power, resistance, surveillance.

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BIM IMPLEMENTATION PLANS: A COMPARATIVE ANALYSIS

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To realise the benefits of BIM in construction management using (4D and 5D applications), it has to be implemented first. There are various BIM implementation plans to select from; with BIM features and guides, companies better understand BIM concepts and can easily choose a plan to apply in their operations. A literature review was conducted and 15 different definitions of BIM were encountered. Twelve different BIM implementation plans were found in publications by academics, software vendors and Architecture/Engineering/Construction (AEC) industry professionals. Those implementation plans were compared using a matrix which covers the complete building lifecycle. This research concludes that out of the 12 implementations plans, three were equipped with additional guides attached to their plans, simplifying project data collection; namely those by Autodesk, Penn State University and Indiana University. One implementation plan that scored very highly (based on 16 key issues identified from the three categories of stakeholders specified in this project) was the implementation plan proposed by a major software vendor. BIM is poised to solve many of the shortcomings reported in the construction industry. However, before realising the full potential of BIM in construction management, it needs to be systematically implemented.

Keywords: implementation plans, BIM, construction management.

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CONSTRUCTION DESIGN AND TECHNOLOGY

THE ROLES OF REPRESENTATIONS IN BUILDING DESIGN: MATERIALITY AND VISUALISATION

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Mock-ups, scale models and drawings are ubiquitous in building design processes, circulating between various stakeholders. They contribute to the gradual evolution of design, but what else can specific material representations do for the building design and project? The full scale model of a hospital single bed room can be different in terms of detail and medium, but in what sense might it perform different and similar functions? The mobilization of multiple forms of representations and visualizations suggest that design materialization might have several important roles to play in negotiating the building design and project, including in the exposition and resolution of controversy in the design process. The paper compares the use of two different forms of representation of the same imagined space – a single room in a hospital, and produced for similar purposes – to ascertain what the optimum (or minimum) spatial requirements should be to allow effective care of patients. The first representation is a three dimensional augmented reality model of a single room for a new hospital in the UK, using a CAVE (Cave Automatic Virtual Environment) where the room is reproduced virtually at one-to-one scale, and which can be explored or navigated using head-tracker technology and a joystick controller. The second is a physical mock up of a single room for a Danish hospital where actual medical procedures are simulated using real equipment and real people. Drawing on Latour's concepts of matters of concern and matters of fact, we compare these two representations to provide insights into the way different media produce specific senses of the design or imagined space, with consequences for on-going design work, and for the settling of controversy.

Keywords: simulation, hospital design, matters of concern,

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STANDARDISATION OF SPECIFICATION DRIVEN BUILDINGS WITH SERIAL AND REPEAT ORDER DESIGNS

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Government policy-makers are continuing to affirm the need for greater economies through standardisation. The benefits of standardisation seem straightforward: repeated designs offering economies through rationalisation and greater use of preassembled manufactured components as a result of a closer engagement with supply chains. However, a closer investigation of standardisation shows it to be more complex; individual client needs, unique site conditions, planning legislation, late contractor engagement, inadequate knowledge and intermittent manufacturer supply are some of the factors that conspire to limit the benefits of standardisation. This research, as part of an Engineering Doctorate study, examines repeat- and serial-order standardised buildings through multiple case studies where the reasons for their adoption are explored from various stakeholder perspectives. It tests existing theories from literature on standardisation in design and construction efficiency, with an emphasis on specification driven ‘non-iconic’ buildings. With one-off projects the benefits of standardisation are expected to be limited to efficiencies within a project, and there may be limited engagement with a supply-chain. On multiple projects, with dimensionally standard spaces, even in multi-stage tender situations, standardisation is also limited and clients are not strongly motivated to engage with manufacturing. However, there are other projects where clients, designers and contractors have taken an ‘enlightened self-interest’ to collaborate, particularly for repeat order projects, and this leads to an optimised process between the design team, the contractor and their supply chains. These latter projects have better defined briefs and benefit from successive refinements of more linear rationalised design processes with increased use of standardisation and preassembly, particularly for the more dimensionally standard areas of the buildings.

Keywords: client, briefing, design, standardisation, prefabrication

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BEYOND SCORING: ADVANCING A NEW APPROACH TO THE DESIGN EVALUATION OF NHS BUILDINGS

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The engagement of project stakeholders in the design evaluation of National Health Service (NHS) buildings is critiqued to evaluate the current effectiveness of NHS policy which prescribes the use of quantitative, positivist survey instruments to capture stakeholder views. An alternative conceptual framework for design evaluation is presented that privileges the practice of design evaluation as the social interaction of project stakeholders. Empirical evidence from two longitudinal case studies of newly-constructed mental health facilities illustrate the success of this innovative approach in improving patient healthcare outcomes and reducing operating costs. It elucidates and enhances both the praxis and practices stimulated by current approaches to design evaluation. It raises important implications for the future development of UK Government policy to substantively improve the design quality of NHS healthcare buildings and, in turn, improve patient healthcare outcomes.

Keywords: design evaluation, design quality, NHS policy, practice, praxis, social interaction.

EXPLORING PROCESS, PRODUCTIVITY AND STRUCTURE IN DESIGN

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It is increasingly difficult to benchmark performance and record, manage and transfer information effectively. Modern construction projects are complex and the roles and responsibilities of designers are inconsistent. This raises concerns about rework and inefficiencies in construction projects. To address these concerns is an opportunity to improve project performance and profit margins. Increasing calls for innovation, growing client involvement and input from a range of stakeholders have led to the creation of complex project management structures. This has added to the centrality of the design process, underlining the need to understand and assess the design process and its productivity. The research forms part of a project intended to investigate the productivity of designers and engineers, with the aim of enhancing design process productivity. An improved understanding of design processes and identification of the factors that may contribute to design productivity within a design-led organisation is intended to help improve the management of design activities. As part of an ongoing PhD project, the aim is to present a critical review of literature in order to understand the complexity of design and to explore the roles of effective management, organizational structures and emerging tools in the potential success of design. The literature reveals that the design process and interactions with stakeholders increasingly requires operational and managerial complexity. The relationships between technical, operational and managerial complexity requires a better understanding of what design actually is, why it is complex and how this impacts project organizational structure. It would be useful to focus the next stage of the research on the effectiveness of the design process, than its efficiency.

Keywords: design complexity, design process, organizational structure, productivity.

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INDUSTRIALISED BUILDING SYSTEM (IBS) IN MALAYSIAN HOUSING: AN EMERGING INNOVATION SYSTEM EXPLANATION

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The building industry has many challenges, such as growing demand for affordable housing, increasing construction costs, relying on unskilled labour and failing to produce acceptable quality of construction outputs. These challenges are prevalent in most country in the world including Malaysia and have always been associated with adherence to existing practices and a reluctance to accept innovations. This situation has prompted policy-makers in Malaysia to set targets for the introduction of Industrialised Building System (IBS) but the aims have yet to be accomplished. Based on the System Functions approach, this paper aims to create an understanding of the IBS development pattern in Malaysian housing construction from 1963 to 2010. The data was collected from archive data and verified with interviews. From the findings, positive perception in IBS and government policy on IBS development are the two inducement mechanisms identified. Meanwhile, uncertainties of IBS opportunities among potential construction clients, inadequate knowledge of relative between investments and benefits, inconsistencies of demand for IBS application, lack of IBS suppliers, and unpreparedness among construction designers and contractors are the discovered blocking mechanism. Based on this development pattern, the blocking mechanisms identified are stronger vigorous and have decelerated IBS development in Malaysian housing projects.

Keywords: Malaysian housing construction, industrialised building system, technological transition, innovation system, system function.

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DISASTER MANAGEMENT

HOSPITAL FACILITY RESILIENCE: AN ADAPTATION FRAMEWORK FOR EXTREME WEATHER EVENTS

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The fragility of hospital built infrastructure to extreme weather events has been widely acknowledged. However, the way in which hospital stakeholders interact with their built environment during such events has not. To address this important but missing element in hospital resilience thinking, a content analysis of thirteen hospitals disaster planning documents is reported. Using resilience and learning theories, the role of built environment assets in disaster management planning strategies is discussed. A conceptual framework is proposed to help hospital stakeholders learn about and adapt to their built environment in response to extreme weather events. This framework provides new insights, both theoretical and practical, into the important role of hospital infrastructure to healthcare delivery during such events.

Keywords: extreme weather events, resilience, built environment, hospitals, organisational learning, content analysis

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IDENTIFYING THE ADDED-VALUE OF VARIOUS ROLES IN THE POST-DISASTER RESPONSE AND RECOVERY OF CHRISTCHURCH

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Structural and infrastructural damage from the Christchurch earthquakes of September 4th 2010, February 22nd, and June 13th 2011 resulted in necessary and extensive responses from various primarily publicly funded organizations and professional consultants. The multi-disciplinary management framework developed by Kestle (2009) for collaborative international projects was previously tested in scientific, humanitarian aid and post-disaster contexts in Darfur, Aceh, and Antarctica and found to be very effective in modeling and understanding the in-field and management issues related to the provision of aid in remote locations, and following natural disasters. In this paper, the authors extend the application of that framework to identify where value was added (both perceived and actual) by the various roles in the post-disaster response and recovery of Christchurch. Interviews were conducted with a range of operational and consultant participants, to collect data from a representative sample of the wide ranging aid and recovery population involved in the response and recovery post-disaster phases in Christchurch. The Kestle (2009) framework provided the vehicle to compare what was seen and experienced in the field with what may have been planned by management in the various organisations. The data analysis identified the main challenges of this particular disaster as a lack of a relevant management framework in the early recovery phase, gaps in knowledge, and protracted decision processes. The added-value by the various roles was also identified for future reference.

Keywords: added value, Christchurch , framework, management, post-disaster.

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BUILDING CAPABILITY FOR DISASTER RESILIENCE

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All levels of government recognise the widespread devastation of communities by natural or other disasters. They have responded with emergency management arrangements and policies to enhance government and community capacity to anticipate, withstand and recover from disastrous events. Although the construction industry has a significant role to play, particularly in recovery and reconstruction, it has not generally been considered as a key stakeholder in building capability for disaster resilience. One barrier to more active involvement of the construction industry in disaster response and management is that traditional methods of construction project management have been criticised as too time consuming and inflexible for use under circumstances of high uncertainty, requiring rapid response in complex multi-stakeholder environments. The 2011 Queensland floods represent one of the most disastrous extreme weather events of recent times. Using this event as a case study, this paper presents results of analysis of institutionalised discourse concerning structures, policies and procedures for disaster management, and official inquiry reports providing details of response and recovery activity. The aim of the research is to identify the positioning of project management in the disaster management discourse as a first step towards earlier and more proactive involvement by the construction industry and use of project management approaches that contribute to disaster resilience.

Keywords: project management, construction, disaster, response, resilience.

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STAKEHOLDERS' APPROACHES TOWARDS NATURAL DISASTERS IN BUILT ENVIRONMENT: A THEORETICAL FRAMEWORK

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Built environment is subject to many risks due to the unique features of construction tasks, such as long lead item procurement, complicated design processes, safety, quality and environment, financial intensity, dynamic organization structures and natural disasters. Natural disasters are becoming more frequent, expensive and devastating globally. They also jeopardize society, performance of economy, built environment, and other socio-economic and physical conditions. While natural disasters cannot be eliminated, successful construction projects are those where natural disasters are effectively managed by stakeholders. Little is known about stakeholders' responses towards natural disasters in construction projects and built environment. Furthermore, past theories on shaping stakeholders' approaches towards natural disasters have been shown to be inadequate in terms of their ability to represent real-life practice and measure the stakeholders' responses against disasters. Hence, the aim of this paper is to develop a theoretical framework on stakeholders' approaches towards natural disasters that integrates four theories, namely: (i) stakeholder theory; (ii) macroeconomic theory; (iii) disaster management theory and (iv) decision making theory. With disaster risk management theory providing the practical backbone of the theoretical framework, the other three theories are able to provide the additional explanation of various aspects of stakeholders' decision making process. Through disaster risk management theory, we are able to support the reactive or proactive approaches of stakeholders before, during and after natural disasters. Macroeconomic theory plays crucial role to choose the appropriate socio-economic variables in natural disaster management process. Decision making theory and stakeholder theory altogether pave the way to select the pivotal stakeholders and to manage their behavioural patterns against natural disasters. The paper concludes the anticipated benefits of proposed theoretical framework as (i) direct comparison of different stakeholders' approaches (reactive and proactive) against natural disasters in built environment; (ii) high-level disaster management planning decisions; (iii) contemplating disaster risk analysis and disaster risk response simultaneously.

Keywords: built environment, disaster management, stakeholder approaches, theoretical framework

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EDUCATION AND LEARNING

FRAMEWORK FOR FORMATIVE ASSESSMENT LEARNING STRATEGIES IN BUILT ENVIRONMENT HIGHER EDUCATION PROGRAMMES

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Formative assessment has begun to be recognized as a driving force for enhancing student learning. This paper addresses the context of Built Environment (BE) undergraduate programmes and the findings from a research project in the context of the changing Higher Education (HE) environment. The analysis of the literature on formative assessment shows that there is a common concern among the educational researchers about the function and position of assessment in HE today. The overall aim of this research is to contribute to an improvement in the quality of student learning in BE undergraduate education through the development of a theoretical framework for formative assessment. The application of a mixed methods approach and more particularly a constructivist stance to the research was adopted. A four-phase sequential approach has its key characteristic assessed and the advances in conducting and evaluating this design are presented. The results and analysis of all four phases of the research, which gives the views and preferences of senior academics, programme managers/leaders and lecturers/teachers in the BE in Ireland, are presented. From this ongoing research work a framework for a more scholarly approach to assessment in BE has been developed and piloted with selected student groups. The purpose of this framework is to provide an opportunity for undergraduate learners through their lecturers/teachers to change approaches to assessment practice so that their learning is enhanced to a level where they can become more self-regulatory and autonomous.

Keywords: assessment, formative, summative, higher education, built environment, mixed methods research, undergraduate.

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DEVELOPING AN UNDERSTANDING OF RESEARCH PRINCIPLES TO SUPPORT POST-GRADUATE EDUCATION IN THE BUILT ENVIRONMENT

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Most research universities require some combination of standardized classroom teaching and independent research as part of a post-graduate level plan of study. Increasingly construction management, construction technology, architecture, and related programmes that award degrees related to the built environment (BE) are awarding post-graduate degrees. Frequently these degrees, unlike traditional engineering degrees which test theory from a quantitative or positivist position, relate to issues that are more difficult to measure using strictly quantifiable metrics. Because the managerial issues faced by these graduates deal with human interaction and behaviour, research in the BE often resembles social science research to a greater degree than traditional scientific research. As post-graduate programmes in the BE expand, there is an increasing need for student support in the research fundamentals that are required to complete valid research on construction and design issues. Small programmes can rely on the individual mentorship of students, but as student populations grow a more formalized approach is needed to support varying research methodologies employed by post-graduate students as they complete their thesis or dissertation obligations. This paper is an examination of the research fundamentals approach to post-graduate education being used by construction related research programmes in a sample of universities in the US and the UK/Ireland. Emphasis was placed on understanding the current educational support for the understanding of research fundamentals critical to research in the built environment. The paper utilizes both a literature review and a survey instrument. Specific areas of examination include information detailing the educational unit(s) within the university with responsibility for teaching research fundamentals, research fundamentals courses available, the research philosophy or approach emphasized, and the text or other literature support utilized to advance valid research design by post-graduate students. As academic processes develop at post-graduate level there appears to be a consensus that the need for research principles courses is accepted. Where the position differs is at what level this course should be offered.

Keywords: graduate education, research, curriculum development, validity, methodology

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EFFECTIVENESS OF THE CONSTRUCTION MANAGEMENT COURSES

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This research assesses the effectiveness of current MSc. Construction Project Management programmes within the UK and Ireland. A review of published prospectuses is used to create questionnaires for universities, graduates and employers. Responses provide an insight into programme creation and their relative success in addressing the needs of industry and in achieving other educational objectives. Since the majority of learning institutions have attained professional accreditation, it is useful to review these awards and to assess their potential value to both graduates and industry alike. Interviews are conducted with representatives from the main professional accrediting bodies to understand their procedures and rigour in enforcing standards of education and training. The results show that project management education could be further enhanced by the inclusion of more practical learning and that current programmes place greater emphasis on hard skills at the expense of the softer human skills. There is clearly a need for a closer working relationship between academics and practitioners to tackle the perceived gap between theoretical learning and construction practice. Learning institutions can use the findings to improve their programmes and address the education deficiencies identified by the industry, by the professional institutions and by graduates.

Keywords: education, professional accreditation, project management.

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COMMUNICATION MODES AND PERFORMANCE OF VIRTUAL DESIGN TEAMS IN AN UNDERGRADUATE BUILDING PROJECT

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Effective communication between parties in distributed design teams is essential for successful construction projects. However, there is little consensus and understanding on the factors influencing the distanced communication between these multidisciplinary parties. Many effective practices that are applicable to traditional collocated teams may no longer be relevant and require a thorough examination. This paper reports an on-going research project that aims to investigate the factors influencing the communication effectiveness of virtual design teams in a case project undertaken by final-year undergraduate students in two institutions in Canada and the UK. The empirical work involved a questionnaire survey of 69 students, comprising 32 UK (civil/structural engineering) and 37 Canadian (architectural) students. The findings suggest that there is tendency for different communication modes used by the two professions, with architects preferring visual and kinesthetic modes, and civil/structural engineers preferring aural and read/write modes, although this was not statistically significant ($p=0.286$). Higher levels of trust could be sustained by providing evidence of consistent performance over the course of the project. The architectural students and female participants are more likely to exhibit higher levels of trust to their counterparts and higher levels of satisfaction with team working. The findings reveal the potential influence of disciplinary training on the preferred communication modes and the development of effective virtual collaboration. Additionally, the research provides material for further reflection and may serve as a useful consideration for future development of a guiding framework for effective training of built environment professionals.

Keywords: communication, design, education, virtual teams.

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THE INTEGRATION OF DIPLOMATS AND GRADUATES INTO THE CONSTRUCTION INDUSTRY: A PILOT SOUTH AFRICAN STUDY

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Tertiary construction management programmes are challenged in terms of producing diplomates, and graduates that are deemed suitable by employers and the built environment in general. However, employers and the built environment are also challenged as they have a complementary role to play. Tertiary education transfers knowledge and develops skills to a degree. Experiential training, internship, and the education of diplomates and graduates further develop skills. Consequently, employers fulfil a critical role and need to mentor, and integrate students, diplomates, and graduates into their organisations and the overall built environment. A study currently being conducted among members of a regional employer association to determine perceptions, and to provide feedback relative to diplomates and graduates, provides the basis for the paper. The following are reported on: the importance of competencies relative to subject streams and the rating of diplomates and graduates relative thereto; the importance of competencies relative to the nine functions in an organisation and the rating of diplomates and graduates relative thereto; and the importance of competencies relative to the functions of management work and the rating of diplomates and graduates relative thereto.

Keywords: construction management, diplomates, employers, graduates, South Africa

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CURRICULUM INNOVATION IN TRANSNATIONAL TEACHING: A PILOT STUDY

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Students are increasingly operating in a globalised world. Off shore education is challenging for students and teachers, as both need to make connections between local and culturally located knowledge and discipline. The relevant literature indicates that the transnational classroom has a number of challenges. Skills and knowledge of off shore and on shore teachers to enhance the quality of off shore learning and teaching are limited and unrealised. Off shore students experience culturally dislocated and disconnected pedagogies which impede student learning, engagement, program cohesion, and graduate outcomes. Yet, the transnational classroom also offers opportunities. Not just from an economic perspective, it offers Universities an opening to build and maintain a global presence and has the potential to offer scholarship benefits to staff and students alike. This paper presents the results of one of RMIT University's Learning and Teaching Investment Funded applied research project. The aim of this project, trialled as a pilot was to improve student learning experiences, outcomes and employment opportunities by developing and implementing a transnational educational partnership comprising; on and off shore teachers, students, and local industry stakeholders. This partnership used focus groups, interviews and surveys to develop and deliver three interactive workshops designed to integrate international and local contexts and enhance student's learning and work. The results show that the partnership between on and off shore teachers introduced a change in teaching practice developed through a partnership with their local and off shore teachers, each other and local industry. In addition to enhanced student learning outcomes, opportunities for professional development for teachers were also realised. The success of this pilot has led to changes in the Bachelor of Applied Science Construction Management curriculum and teaching practices at RMIT University.

Keywords: construction management, curriculum development, teaching and learning, transnational education.

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WORKSHOPS AS EMBYRONIC BOUNDARY OBJECTS FOR COLLABORATIVE UNIVERSITY-INDUSTRY INNOVATION IN CONSTRUCTION

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The authors participated in different capacities in a project originally conceived for the transfer of knowledge from university-based research to the engineering-construction industry. The project's original aim was 'to collect knowledge from across the [...] portfolio' of a university research centre and re-package this knowledge to meet the business needs' of the member companies of an engineering-construction industry association. We took the opportunity the project created of exploring whether and how the social worlds of construction academics and engineering-construction industry practitioners might cooperate to create the conditions for collaborative innovation in spite of differences of a kind often deemed to be barriers to university-industry collaboration. Through an analysis of the project's unfolding between construction-industry and academic parties, we first reveal some of the apparent differences between them and then consider the possibility that boundary objects might facilitate cooperation for innovation without eliminating the differences. We pay particular attention to workshops as boundary objects.

Keywords: innovation, knowledge transfer, technology transfer, university-industry links.

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A STUDY ON NEW CONSTRUCTION TECHNIQUES AND SKILLS TRAINING WITH FOCUS ON THE PLASTERING SUBCONTRACTOR IN JAPAN

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The purpose of this study was to establish the contents and methods of a vocational education program for modern, advanced-level plasterers. The interview survey confirmed that there is a serious shortage of vocational education resources available for advanced-level plasterers. The first questionnaire survey for seminar attendants during September 2005 and November 2007, conducted in ten regional blocks nationwide, clarified the basic attributes of plasterers. The results of analysis, by multivariate statistical method (Hayashi's Quantification III) and cluster analysis, allowed plasterers to be grouped into eight types, and clarified the characteristics of each plasterer type as well as their relationships with each other when separated into the 10 regional blocks. In the follow-up survey in August 2008, a questionnaire completed by plastering site supervisors was analyzed. This analysis facilitated a thorough understanding of the current work responsibilities of plastering site supervisors, and the types of vocational education that will be needed by advanced-level plasterers in the future. Regarding the training methods necessary for the vocational education of advanced-level plasterers, training types were broadly divided into on-the-job training and off-the-job training, and then further sub-classified into 15 training types. Detailed vocational education contents were proposed for each sub-classification. Vocational education for plastering site supervisors trained through off-the-job training was implemented through a collaboration of the Japan Plasterers' Association and a university architecture department. The contents were described using a relational diagram. The results of the study were divided into the eight national types of plasterer mentioned above in order to facilitate vocational education for plastering site supervisors and advanced-level plasterers in accordance with the construction industry policy outline. In addition, the research results were used to establish and propose vocational education contents and methods based on the type of training required for each plasterer type.

Keywords: plastering site supervisor, architectural skills education, management education, Hayashi's Quantification III, multivariate analysis, cluster analysis

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EQUALITY AND DIVERSITY

GENDER INEQUALITY IN THE CONSTRUCTION INDUSTRY: LESSONS FROM PIERRE BOURDIEU

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Despite a range of equality legislation and initiatives, the construction industry remains one of the most male dominated sectors. Women are under-represented in all construction occupations and professions. Much of the current literature describes the difficulties experienced by women who work in this sector including cultural and structural barriers, such as harassment and discrimination, limited networking opportunities and long and inflexible working hours which often result in poor career prospects and high levels of stress for women. This paper proposes that Bourdieu's theoretical framework can be used to explain the continuing homogeneity of the construction industry professions. Bringing together qualitative interview findings from several research projects with construction industry students and professionals, this paper argues that Bourdieu's thinking tools of symbolic violence and misrecognition can be used to understand women's persistent inequality in the construction industry. The findings problematise existing policy recommendations that argue women have different skills that can be brought to the sector (such as co-operation). Such policies reinforce the gendered nature of the construction sector's habitus and fail to recognise how the underlying structures and practices of the sector reproduce gendered working practices.

Keywords: Bourdieu, equality, gender, construction, women

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WORKING HOURS IN A LARGE NEW ZEALAND CONSTRUCTION COMPANY

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Long working hours and weekend working are an integral part of many jobs in the construction industry, and are job characteristics that are linked to work-life conflict, which adversely affects employees' ability to achieve work-life balance. Furthermore, the industry's culture of long working hours limits its ability to attract and retain talented employees. Since much of the work-life balance research in the construction industry focuses on working hours, this research aimed to identify the typical working hours of the professional and managerial level staff within a single large New Zealand construction company. One hundred and twenty one (121) head office and site-based employees responded to an online survey. Results support the assertion that New Zealand construction industry employees tend to work long hours, and that work location affects working hour demands. Qualitative results suggest some work-life conflict associated with working long hours and weekend work exists. The New Zealand construction industry must provide a supportive workplace culture in which to address these issues, and provide reasonable working hours, in order to find a balance that is suitable to employees, companies, and the industry as a whole.

Keywords: contracting, human resource management, work hours, work-life balance

WOMEN AT TOP LEVEL MANAGEMENT AT CONTRACTORS IN DENMARK AND NORWAY

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Strategic management and leadership in the building sector will gain increasing importance as globalization and shorter product lifecycles will put pressure on company competences in moving fast and agile. A broader mobilisation of human resources at the top level could be a central avenue to improve strategic management. Through new recruiting the composition of the top level management could be strengthened. Today the building industry encompasses relatively few managers with strategic management competences and women at this level are very few. The paper uses institutionalist theory to explain the dynamics in changing and developing top level management. The theoretical framework argues for five interlinked domains of the individual, the enterprise, the strategic management, the board and the environment. Institutions in all areas contribute to the experienced constraints. Based on an exploratory study of Danish and Norwegian female representation as CEOs, member of boards of directors and member of boards shows very low representation of women. Four competing institutions regarding female representation are identified the male dominant, the hostage, the voluntarist and the politically correct. The present status for the Danish contractors can be characterized as the hostage, as one woman in the board seems to be the present pattern. And Norway is less different than one should think. In Denmark as a newly launched reform encompass a strong voluntary element. An EU reform is therefore a more likely driver for politically correct institutional reform.

Keywords: equal opportunities, institutional theory, women, top-level management

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JUGGLING WORK, FAMILY... AND LIFE IN ACADEMIA: THE CASE OF THE “NEW” MAN

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Although the notion of the “new man” is gaining currency, there is very little research on how he manages to balance work and family. It is therefore timely to look more closely at this issue. We present preliminary results from an explorative pilot study on work-life balance and “new men” in academia. Using an interpretative approach, in-depth interviews were carried out with academics from construction-related university departments in Britain and Sweden. Drawing on figures from the OECD and on Hofstede’s masculine (Britain)/feminine (Sweden) dimension, we found that the small population of academic respondents studied struggled with the same kinds of work pressures and desires to achieve/perform according to the traditional norm of a masculine society. However, the Swedish men were more inclusive of the whole family life/circumstances in their accounts while the British men tended to be more focused on themselves. Since the analysis of the data is still on-going, the findings remain tentative. Early conclusions suggest that a satisfactory juggling of work-life balance for all these men is dependent on negotiations and re-negotiations of responsibilities between them and their partners. Some British men seemed to expect compromise and sacrifice by their partners, while for all Swedish men there was an expectation of compromise and sacrifice by both partners.

Keywords: academia, family, new man, work-life balance, cross-national comparison.

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STRIVING FOR INCLUSIVE DESIGN IN THE BUILT ENVIRONMENT: LEARNING STRATEGY ADOPTED BY POLICY IMPLEMENTERS AT LOCAL AUTHORITIES IN ENGLAND

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The research will explore views on inclusive design policy implementation and learning strategy used in practice by Local Authorities' planning, building control and policy departments in England. It reports emerging research findings. The research aim was developed from an extensive literature review, and informed by a pilot study with relevant Local Authority departments. The pilot study highlighted gaps within the process of policy implementation, a lack of awareness of the process and flaws in the design guidance policy. This has helped inform the development of a robust research design using both a survey and semi-structured interviews. The questionnaire targeted key employees within Local Authorities designed to establish how employees learn about inclusive design policy and to determine their views on current approaches of inclusive design policy implementation adopted by their Local Authorities. The questionnaire produces 117 responses. Interestingly approximately 9 out of 129 Local Authorities approached claimed that they were unable to participate either because an inclusive design policy was not adopted or they were faced with a high workload and thus unable to take part. An emerging finding is a lack of understanding of inclusive design problems, which may lead to problem with inclusive design policy implementation, and thus adversely affect how the built environment can be experienced. There is a strong indication from the survey respondents indicating that they are most likely to learn about inclusive design from policy guides produced by their Local Authorities and from their colleagues.

Keywords: implementation, inclusive-design, English local authority, policy, learning.

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AN ASSESSMENT OF OCCUPANTS' EXPECTATION IN THE DELIVERY OF LOW-INCOME HOUSING IN SOUTH AFRICA

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Low-income housing provision has been a major focus of the government in post-apartheid South Africa. While success can be noted, there is a growing concern on the housing expectations and satisfaction of the housing occupants'. Utilizing post-occupancy survey conducted in four locations that had benefited from the government housing subsidy scheme, the research identifies how the expectations of the occupants of low-income housing can be met in the Gauteng Province of South Africa. The results from the post-occupancy survey revealed that most of the beneficiaries' housing needs were not met, as a majority of the respondents informed that they had expected bigger units; however, when they were allocated the houses, the expectation was not met. Though, a major obstacle while the respondent's expectation was not met pointed toward the lack of consultation between the Department of Human Settlement and the occupants'. A comparison is also made to ascertain the correlation between meeting of occupant's expectation and the maintenance of the houses. It is suggested that the Department of Human Settlement should conduct occupants need assessment on future housing project to be developed and on a consistence basis should employ post-occupancy survey to inform, improve and guarantee the expectation and housing satisfaction of the beneficiaries' of subsidised housing units in South Africa.

Keywords: housing subsidy beneficiaries, housing satisfaction, low-income, needs and expectations, occupants

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FORECASTING AND DECISION MAKING

NEURAL NETWORKS FOR MODELLING THE FINAL TARGET COST OF WATER PROJECTS

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Producing reasonably accurate cost estimates at the planning stage of a project important for the subsequent success of the project. The estimator has to be able to make judgement on the cost influence of a number of factors including site conditions, procurement, risks, price changes, likely scope changes or type of contract. This can shroud the estimation process in uncertainty, which has often resulted in project cost overruns. The knowledge acquisition, generalisation and forecasting capabilities of Artificial Neural Networks (ANN) are explored in this pilot study to build final cost estimation models that incorporate the cost effect of some of the factors mentioned above. Data was collected on ninety-eight water-related construction projects completed in Scotland between 2007-2011. Separate cost models were developed for normalised target cost and log of target costs. Variable transformation and weight decay regularisation were then explored to improve the final model's performance. As a prototype of a wider research, the final model's performance was very satisfactory, demonstrating ANN ability to capture the interactions between the predictor variables and final cost. Ten input variables, all readily available or measurable at the planning stages for the project, were used within a Multilayer Perceptron Architecture and a Quasi-Newton training algorithm.

Keywords: cost estimation, cost modelling, neural networks.

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FORECASTING THE NUMBER OF JOBS CREATED THROUGH CONSTRUCTION

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The construction sector is one of the largest single contributors to employment. A wide and varied set of metrics is used by official channels to predict the number of jobs that will be created for a given value of construction expenditure. These values tend to be shrouded in context specificity (ie, a peak workforce, or number of jobs created for one year) which meet the agenda of the organisation making the announcement. The research reported in this paper reviews the outcomes of five years of research into labour forecasting culminating in the development of the Labour Forecasting Tool (LFT). The research explores three approaches to deriving labour coefficients (the amount of labour per £m of construction value): i) a review of historic data produced by contractors; ii) a theoretical build-up of labour from bills of quantities and iii) an analysis of published UK national statistics. The shortfalls and advantages of each approach are discussed along with the results of a triangulation of the three methods to test the accuracy of the results. Encouragingly, the results point towards a strong agreement between the three approaches. However, whilst the labour coefficient can provide an estimate of the total labour demand in person-years this must be translated to a meaningful measure of the construction jobs created. To do so requires an understanding of the labour flow during a project. The LFT is capable of producing a month-by-month, trade-by trade forecast for a project by the use of a bespoke algorithm. Using the LFT, results are presented for eight typical projects within seven construction sectors. The significant impact of project duration on peak labour demand is shown. The conclusion can be drawn that any discussion of 'jobs created' must be clearly presented in the context in which it is reported.

Keywords: employment, labour forecasting, productivity

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A SYSTEM DYNAMICS-BASED METHOD FOR DEMAND FORECASTING IN INFRASTRUCTURE PROJECTS - A CASE OF PPP PROJECTS

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Concession contracts are one of the most popular PPP arrangements. However, there are still a few problems regarding the successful implementation of such arrangements, such as estimating a realistic figure for the demand of services offered by the facility. Lack of demand, or demand variation, is a widespread practice when developing infrastructure projects. In the case of concessions, such practices are the origin of significant risk as the forecasted demand is a key variable in the financial and economic evaluation of any PPP project that needs to be accurately identified and then managed. Demand forecasting is a complex and dynamic process, as several inter-related qualitative and quantitative factors affect demand. This paper proposes a system dynamics-based method in which different factors affecting demand are considered and modelled holistically. The system dynamics concept has been employed to build up a set of cause-effect diagrams which will finally be incorporated to develop a conceptual demand model. This model establishes the causal structure of the demand system, which will help to portray and define the impacts of different factors on demand volume.

Keywords: cause-effect diagrams, concession, demand forecasting, system dynamics.

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AN EXPLORATION OF THEORETICAL CONCEPTS AND METHODS FOR ASSESSING RISK IMPACTS ON THE VARIABILITY BETWEEN CONTRACT SUM AND FINAL ACCOUNT IN DESIGN AND BUILD PROJECTS

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Design and Build procurement has been steadily increasing in popularity over the past number of years. Although it can provide some advantages, it can also lead to being a risky procurement method for both owner and contractor if the risks are not identified in advance and managed throughout. Therefore the overall aim of this study is to identify, assess and model the risk factors impacting the variability between the contract sum and final account in client-led and contractor-led Design and Build projects. The work presented in this paper is at the preliminary stage of the research programme and it looks into the possibility of developing a methodology for assessing risk impacts on the variability between contract sum and final account in design and build projects. As a first step, a detailed review of literature was made to establish the growing use of design and build procurement and the risk inherent in this procurement method. Secondly, different perspectives of risk were examined using the cognitive model of risk so as to position this study in the wider context of existing body of knowledge in this domain. The insights gained from the foregoing steps then helped in devising a methodological framework for assessing the variability between the contract sum and final account in client-led and contractor-led Design and Build projects.

Keywords: contract sum, design and build, final account, risk, variability

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FORECASTING CAPABILITY OF A CONSTRUCTION ORGANISATION MODEL: 10 YEARS LATER

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The overall financial performance of construction organisations in Malaysia depends on the level of construction activity in the national economy. This in turn is a function of the state of the national economy which is cyclical in nature with a return period of approximately 10 to 12 years. This research seeks to test the validity of an organisation model first developed in 2001. In addition, the model is tested for its performance forecasting capability by comparing the forecast result generated from the model against the organisation's actual financial performance over the most recent economic cycle. This study shows that the accuracy of the model's forecast is dependent on regular updating of the model. It is found that with regular updates of the model's internal and external variables to reflect the strategic changes in the organisation and the state of the economy, a model with good forecasting capability can be produced. The validated model can be used to test the impact of proposed new strategies on the organisation's financial performance.

Keywords: construction organisation, modelling, system dynamics, validation.

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DECISION-MAKING IN FAÇADE SELECTION FOR MULTI-STOREY BUILDINGS

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The design and construction of multi-storey buildings faces a multitude of demands such as aesthetics, cost, energy efficiency, and occupier comfort; with façades on both new and re-used buildings playing a key role in helping to meet these demands. The process of façade selection is aided by a plethora of decision-making tools, yet façade decisions are often largely guided by cost and aesthetics. Poorly specified façades can potentially expose developers, owners and occupiers of multi-storey buildings to risks such as poor thermal comfort, glare, and increased operational costs. The aim of this paper is to explore the current state of façade decision-making, with the objectives of discovering who is making the decisions and when, and what problems are perceived and what potential solutions might exist. Literature pertaining to façades, multi-storey buildings and façade decision-making is reviewed. Experience of façade decision-making in today's construction industry in the UK is collected via semi-structured interviews with construction professionals. The findings show architects as leading the initial façade decisions, with clients and planners making the final decisions. Very few decision-making tools were revealed as being used: namely whole life cost analysis, life cycle cost analysis and simulation. Further research is proposed to define the roles participating in façade decision-making for multi-storey buildings.

Keywords: building façade, decision-making, multi-storey building.

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COMPARISON OF THE GREY MODEL AND THE BOX JENKINS MODEL IN FORECASTING MANPOWER IN THE UK CONSTRUCTION INDUSTRY

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Accurate forecasts of manpower in the construction industry are very important for the government, educational institutions and individual construction firms in their manpower planning. Although many good forecasting models have been developed, they require a sufficient amount of good-quality data to produce accurate results. Grey systems theory developed by Deng has become popular due to its ability to deal with systems in which some information is unknown. Grey models require only a limited amount of data to estimate the behaviour of unknown systems. This paper compares the grey model with the Box-Jenkins model in the forecasting of manpower in the UK construction industry. A GM (1, 1) grey model is proposed to forecast construction manpower one quarter ahead using manpower data from the Construction Statistics Annual published by the Office for National Statistics covering 72 quarters from 1991 Q1 to 2008 Q4. Within this period, two sets of manpower data were used: the total manpower available for employment (labour supply) and the total number of employees in employment (labour demand). An Excel programme was formulated to execute the forecasts using the grey model. An SPSS programme was used to conduct autoregressive integrated moving average (ARIMA) forecasts (Box-Jenkins model). The minimum mean absolute percentage error (MAPE) forecasted by the grey model for the total manpower and total employees time series was 1.52% and 2.14%, respectively, whereas the MAPE forecasted by the ARIMA model was 1.61% and 2.33%, respectively. Given the small forecasting error, it is concluded that both the GM (1, 1) model and the ARIMA model can accurately forecast manpower in the UK construction sector, but that the GM (1, 1) model performs slightly better than the ARIMA model.

Keywords: manpower forecast; Grey Model; Box-Jenkins Model.

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TIME SERIES ANALYSIS FOR THE PREDICTION OF RC MATERIAL COMPONENTS PRICES IN EGYPT

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Reinforced concrete (RC) as a construction material is widely used in the Middle East and particularly Egypt. Prices of the RC material components usually comprise an important portion of construction project costs. Prices of RC materials have witnessed significant changes and fluctuations over the past 15 years in Egypt, leading to severe impacts on the running projects' costs and to the failure of various projects as well as legal consequences on contracting companies. Factors affecting steel and cement prices (the major cost contributors to RC) have been related in previous literatures to cost of the production process, raw material prices, energy prices, macroeconomic variables, and industry related factors. Time Series Analysis involves the use of historical data to predict the future outcomes and the associated risks. Thus, the objective of this paper is to apply Time Series Analysis to better predict the prices of RC material components in Egypt. Prices of steel, cement, sand and crushed stones were collected for the period from 1997 to 2010. The collected data was divided into two sections based on the economic growth within the studied periods. A computer-based analysis was conducted using ForecastX and SPSS software to apply the Time Series analyses and detect trends, stationarity, and seasonality. Results indicate that the outputs on applying the Time Series models in both programs were nearly identical. Furthermore, the predictions for the last quarter of 2009 and the first two quarters of 2010 were compared to actual past prices as a way to validate the analyses. A reasonable degree of prediction accuracy was concluded for all materials, and in particular cement, although the global financial crisis in 2008 was found to negatively affect the predictive capability of the model. Time Series Analysis in general, although being a good prediction technique in stable economic and industry conditions, cannot predict sudden macroeconomic or other events, and therefore, future research is required to tie in input variables of material costs based on leading cost indicators and to explore how the effects of sudden events can be realized and hopefully predicted, if possible.

Keywords: reinforced concrete, time-series analysis, material prices, Egypt.

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HEALTH AND SAFETY & RESPECT FOR PEOPLE

INCONSISTENT, INCOMPLETE AND INCIDENTAL: SITE SAFETY CULTURE FROM A CONSTRUCTIONIST PERSPECTIVE

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Safety culture is a common concept within both academia and industry, where large UK contractors have made significant efforts to improve the safety culture and consequently the safety of their sites. Although from either perspective, 'safety culture' itself is not yet fully emergent. Academic research has sought to identify and measure safety culture on sites, however such a quantification of culture is something that may not ultimately be possible. Grounded in social constructionism, this study instead sought to explore and examine safety culture in practice. This epistemology enabled the exploration of culture through the discursive patterns and constructional frameworks that surround safety on sites, themselves constructed through shared social practices and resources. Data was collected from five UK construction projects, all over £20m in value, and included site safety signage, safety talk and various safety documents. Discourse analysis, followed by triangulation of the key themes and representations, revealed considerable variation in the constructions of safety on sites. Safety culture was found to be inconsistent, incomplete and incidental; relating to a variety of different realities in a variety of different contexts. This variation not only has significance for the practices of large contractors in their desire to develop safety culture on sites, but also the direction of further academic research. Recommendations for practice were generated, in order to facilitate further improvements in safety on sites.

Keywords: discourse analysis, safety, safety culture, social constructionism.

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EXPLORING HUMAN ERROR THROUGH THE SAFETY TALK OF UTILITIES DISTRIBUTION OPERATIVES

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Cable strikes form a significant safety challenge for the construction industry's utilities sector. Such incidents can and do result in both death and injury for the workforce, as well as costing companies millions of pounds in associated damages and compensation costs. Despite specialised tools, processes and training programmes, cable strikes still occur on a regular basis. The majority of cable strikes are, like many incidents within the construction industry as a whole, attributed to human error. However, current thinking has suggested that human error is itself a symptom, rather than a cause, and theories have developed to position the incident-causing human error action as the final link in a much longer chain. This paper presents an exploratory study which sought to examine this theory within a specific context; the construction utilities sector and cable strike incidents. Seven interviews were undertaken with operatives within their work environments, which gathered talk around general safety and cable strike incidents. A thematic approach enabled patterns within the transcribed data to be extracted and contextualised within industry practice. Findings indicated that operatives assigned a variety of different causalities to their experiences of incident occurrence, which were then used to construct a taxonomy of the causal factors of cable strikes from the operatives' perspective. These factors were then analysed within the industry context to construct potential 'causal chains' which are able to link the site incidents to management policy. This study, although exploratory, suggests that application of the systems theory of human error is highly applicable to the construction industry, and that the focus of safety management and safety management research should look beyond operatives on the front line to seek further improvements in safety performance.

Keywords: accidents, human error, safety, utilities.

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THE USE OF EXPERIENCE AND SITUATED KNOWLEDGE IN ENSURING SAFETY AMONG WORKERS OF SMALL CONSTRUCTION FIRMS

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Techniques used by small construction firms with regards to site safety have been found to differ considerably from those of large construction firms. Workers of small construction firms adopt a 'common sense' approach and eliminate procedures that the workers deem bureaucratic rather than practical. This paper is based on a PhD research project which aims to critically investigate 'good' health and safety practices undertaken by workers of small construction firms and in particular explores the informal ways of managing health and safety. The East Midlands region of the UK was chosen for the study of good practice due to a steady decline in accidents and injuries over the past decade. The research is being conducted with a qualitative approach to gain rich data on site practices and workers perceptions. The findings of a pilot study suggest that workers of the small firms use situated knowledge and experience when dealing with health and safety matters. Experienced workers tend to quickly and informally assess potential risks and subsequently manage their work environment so as to prevent injuries or accidents from happening in collaboration with their co-workers. Specific good practices emerging from the research include verbal and non-verbal communication such as gestures with eyes and hands, vital on-the-job training for new workers and insightful guidance by the leaders in order to attain safe work environments. The aim of this project is to create a foundation for further research into the good practices of small construction firms as the area is currently understudied. Much of the literature in the field focuses on problems and issues with health and safety rather than good practice.

Keywords: accident prevention, tacit knowledge, common sense, small firms.

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A REVIEW OF COMPLIANCE WITH HEALTH AND SAFETY REGULATIONS AND ECONOMIC PERFORMANCE IN SMALL AND MEDIUM CONSTRUCTION ENTERPRISES

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Small and medium enterprises (SMEs) constitute over 90% of construction businesses and are vital to construction industry operation. Health and safety regulations in the UK compel all organisations, regardless of their nature or size to comply with health and safety rules. However, there is evidence that the risk of suffering an occupational accident in SMEs is higher compared to large enterprises. For every 100,000 workers in the European Union SME sector there are more than 4100 accidents involving over three days absence; while the same rate is 3088 in large firms. In terms of cost, SMEs spend more to remedy (considering costs of rectification work, fines, prosecutions and sentences) adverse health and safety incidents. Fundamentally, the high cost of human capital and the destabilising effects of health and safety make the financial performance of SMEs exposed to greater uncertainties and risks. Indeed SME financial performance is often worse than for large firms. Various attempts by previous research work to substantiate the relationship between compliance with safety and financial performance of SMEs seems elusive. The research question is; does compliance with health and safety enhance SME financial performance? It is argued that SME commitment to health and safety spins off into many aspects of business performance and thus they simultaneously also benefit from better profitability. The paper is based on a literature review and an appraisal of HSE prosecutions in the period 2007 - 2011. It is a supplementary study and part of an ongoing PhD that seeks to appraise the effects of investment in health and safety in the UK construction industry.

Keywords: compliance, financial performance, health and safety, SME

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DETERMINANTS OF CONSTRUCTION FIRMS' COMPLIANCE WITH HEALTH AND SAFETY REGULATIONS IN SOUTH AFRICA

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The management of health and safety issues is very significant in the construction industry in South Africa in terms of accident rates and cost to contractors. The costs arise from both the cost of compliance with regulations and the cost of accidents and injuries. In spite of the fact that available evidence shows that construction-related accidents and injuries are on the increase in South Africa, many designers and contractors regard the cost of complying with regulations as unnecessary additional financial burdens. It is against this background that this study investigated the statutory regulations relating to health and safety in construction in South Africa and the level of compliance with the regulations and motivation for compliance by contractors. Data obtained from contractors in a questionnaire survey the Western Cape Province of South Africa were analysed using percentage scores and mean score analysis with the aid of the SPSS software. Although the validity of the findings is limited by sample size used in the survey, it is hoped that the findings will provide empirical basis for a more inclusive survey of H&S in the construction industry in South Africa.

Keywords: health and safety, regulations, enforcement & compliance, construction industry, South Africa.

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SAFETY IMPACTS OF ALCOHOL AND OTHER DRUGS IN CONSTRUCTION: DEVELOPMENT OF AN INDUSTRY POLICY AND CULTURAL CHANGE MANAGEMENT PROGRAM

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There is increasing concern about the impact of employees' alcohol and other drug (AOD) consumption on workplace safety and performance, particularly within the construction industry. While most Australian jurisdictions have identified this as a critical safety issue, information is limited regarding the prevalence of AODs in the workplace and there is limited evidential guidance regarding how to effectively and efficiently address such an issue. The current research aims to scientifically evaluate the use of AODs within the Australian construction industry in order to reduce the potential resulting safety and performance impacts and engender a cultural change in the workforce - to render it unacceptable to arrive at a construction workplace with impaired judgement from AODs. The study will adopt qualitative and quantitative methods to firstly evaluate the extent of general AOD use in the industry. Secondly, the development of an appropriate industry policy will adopt a non-punitive and rehabilitative approach developed in consultation with employers and employees across the infrastructure and building sectors, with the aim it be adopted nationally for adoption at the construction workplace. Finally, an industry-specific cultural change management program and implementation plan will be developed through a nationally collaborative approach. Final results indicate that a proportion of those sampled in the construction sector may be at risk of hazardous alcohol consumption. A total of 286 respondents (58%) scored above the cut-off cumulative score for risky or hazardous alcohol. Other drug use was also identified as a major issue. Results support the need for evidence-based, preventative educational initiatives that are tailored to the industry. This paper will discuss the final survey and interview results.

Keywords: alcohol, drugs, education, safety.

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EVALUATING THE ROLE AND EFFECTIVENESS OF TRAINING INTERVENTIONS IN IMPROVING THE OCCUPATIONAL HEALTH AND SAFETY OF YOUNGER CONSTRUCTION WORKERS: A LITERATURE REVIEW

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Younger construction workers (age 15-24) suffer occupational injury at a much higher rate than older workers, raising concern over the effectiveness of widespread health and safety (H&S) interventions, particularly the quality of education and training provided to young workers about workplace H&S. Based on a review of relevant literature, this paper examines H&S training interventions in the UK and discusses their potential effectiveness in improving the occupational H&S of younger construction workers. The literature review reveals that H&S initiatives for young workers have rarely been examined and evaluated. Without this knowledge and understanding, the development of sound intervention efforts particularly within the complex construction industry context is greatly impaired. Furthermore, education and training programmes may be insufficiently preparing young workers for hazardous work conditions. The paper notes that the traditional 'control-based' approaches, while well intentioned, are limited in their ability to improve H&S for younger workers. To be more effective, such interventions must do more than simply provide young workers with information and must recognise the diversity of development among young learners and the significance of learning within organisations as a social process. More participatory approaches must be adopted, in which younger workers are engaged and involved.

Keywords: health and safety, interventions, learning, training, younger construction workers.

THE PRINCIPAL CONTRACTOR'S ROLE UNDER CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS 2007: AREAS FOR FURTHER RESEARCH BASED ON A QUALITATIVE INQUIRY

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The dissimilarity between principal contractor and contractor organisations under CDM 2007 can often be over measured. In an effort to clearly distinguish the two, so as to understand the role of principal contractor as part of an on-going study, inevitable gaps emerge which invite further research into practice and procedure. Based on a desk research and three (3) focus group meetings with industry experts, it is established through a qualitative inquiry that the principal contractor contributes considerably to the successful implementation of CDM regulations during and after the construction phase. Crucial to this process are the legal and contractual obligations stipulating health and safety requirements before and during the construction phase – *regulation 23(1)(a)*. In order to successfully deliver the construction phase plan, critical to this process yet underestimated are key procedures such as appointment criteria, performance measurement and liability for instance which are hardly mentioned in the CDM 2007 or the practice guidance notes. Clearly, contractors are bound to coordinate numerous activities on construction sites let alone managing health, safety and welfare of employees in accordance with section two (2) of the Health and Safety at Work Act (HASAWA)1974 and part 4 of the CDM 2007 – *duties relating to health and safety on construction sites*. Providing explicit terms of engagement and carefully executed procedures such as appointments can enhance overall health and safety management through construction phase plans. The conclusions of the study therefore suggest further areas of research alluded to above consistent with the literature review and regulation 4(1)(b), 5(1)(2), 6 and 22 - 24.

Key words: CDM regulations, construction phase plan, health and safety management, principal contractor.

A FRAMEWORK FOR ENHANCING AND IMPROVING THE SAFETY CULTURE ON SAUDI CONSTRUCTION SITES

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Improving safety culture is necessary to reduce the number of injuries and fatalities on construction sites internationally. A comparative study of eight developed and Arab countries shows that Saudi Arabia is performing poorest in terms of the rates of major injuries and fatalities, and embedding a safety culture in practice remains a challenge. Three key elements of a safety culture model are identified from the literature: person (safety climate), environment/ situation (safety management system) and behaviour (safety behaviour). These have been constituted into safety culture models. There is also a fourth element relating to organisation. However, there is a lack of research which considers how these components can be integrated into a holistic safety culture model. A conceptual framework is proposed that adopts and integrates these elements for application to the Saudi construction industry. The framework is composed of the three elements derived from the existing frameworks in the literature, and the fourth element of organisational context. The framework will be developed and tested using Saudi construction projects and it is expected that the results of the study will be of benefit to contractors for measuring their own safety culture performance.

Keywords: safety culture, injuries and fatalities, comparative analysis, models, Saudi Arabia.

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CULTURAL INTERPRETATION OF HEALTH AND SAFETY AND ITS APPROPRIATENESS IN THE UNITED ARAB EMIRATES

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In the UK we have a highly regulated construction industry to ensure health, safety and welfare of individuals in the workplace. Yet we still have an unacceptable number of fatalities and accidents. The expectation of professionals when they work abroad is that if the industry is not as regulated then it is not adequate. The research aim was to assess the health, safety and welfare in the construction industry within the United Arab Emirates and explore whether the current provision was adequate following on from the recent construction boom experienced in the region. An online questionnaire survey was carried out with construction professionals with experience of working in the UAE. The sample set produced 101 respondents, from 18 different countries, which provided a wide range of perceptions within the resulting data. The findings from the research provided evidence of a clear division emerging between European participants and respondents from other nations on how they perceived the observed standards within the UAE. The main conclusion drawn from the study is that cultural differences do affect how people perceive health, safety and welfare standards, as they judge what they see from what they are used to in their respective home countries.

Keywords: cultural perceptions, health and safety, United Arab Emirates.

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HUMAN BEHAVIOUR AND CULTURE

CONSTRUCTING A SENSE OF TIME IN PROJECTS: IMPLICATIONS OF A BERGSONIAN VIEW OF TIME

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Construction management researchers have long been concerned with explaining time performance in projects. Many have simply relied on the quantitative notion of 'clock' time to explain how the actions of participants, as rational purposive beings, contribute to the time performance of projects. In this article, the central argument that the emphasis of managerial methods of time management in construction has failed to account for the full spectrum of time is put forward. By researching project time performance as an objectified goal, construction management researchers have not fully imagined the qualitative possibilities of individual time scales (or temporal perspectives) in organisations. Drawing on the work of French philosopher Henri Bergson (1859-1941) and empirical examples from an ongoing ethnographic study of infrastructure development projects in an international airport (MyAirport), it is argued that time cannot be simply represented as a homogeneous numerical order. Rather, researchers must open up potential questions about the multiplicity (i.e. heterogeneity and continuity) of the qualitative experiences of time in (organisational) life, which has hitherto been taken for granted in the field of construction management. Implications of the more plural perspectives of time are also discussed, in relation to space (context), strategy (future-orientation), and sense-making (connecting temporal perspectives).

Keywords: Henri Bergson, sensemaking, temporality, time.

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IDEA CONTRIBUTION IN CONSTRUCTION: IN SEARCH FOR EVIDENCE OF THE INTERFACE BETWEEN IDEA GENERATION AND ITS IMPLEMENTATION

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To innovate, retain competitiveness, succeed and flourish, construction firms need a constant stream of innovative ideas and suggestions from highly motivated and committed employees. This drive for employee engagement in the innovation process becomes even more apparent in the construction sector with problems of multi-tiered subcontracting and the widespread reliance on self employment. This study investigates idea contribution as a crucial interface between idea generation (i.e. creativity) and its implementation (i.e. innovation). Based on the critical review of construction and mainstream literature on innovation, creativity and employee engagement this study proposes a conceptual framework for employees' perceptions of ideas contribution involved in the processes of converting ideas into new products, processes or services. The framework is derived under the assumption that decisions on whether or not to contribute new ideas for organisational improvement is influenced by personal characteristics (knowledge, perceived radicality of ideas, favouring of ideas, openness to experience, self-confidence and curiosity), group and organisational factors (rewards, managerial support, collaborative team culture, position in the company and in the team) that might well be unique to each organisational unit. The philosophical epistemology adopted in this study is realism that shares positions of positivism and interpretivism where the conceptual framework is based on explanations, understanding, argumentation and is tested using a mixed methods research design (experimental tasks, questionnaires and observations). The preliminary results confirmed the influence of assumed factors on idea contribution where personal characteristics were valued higher than group and organisational factors. Discussion of recommendations for the future research is provided.

Keywords: construction sector, idea contribution, idea generation, idea implementation, realism.

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CORRUPTION IN THE SOUTH AFRICAN CONSTRUCTION INDUSTRY: A MIXED METHODS STUDY

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The construction industry is susceptible to corruption and the effects are substantial. The experiences and perceptions of corruption in the South African construction industry are investigated through an opinion survey of clients and construction professionals. A mixed methods approach is used to analyse the response data. Corruption is perceived to be widespread. Conflicts of interest, tender rigging (collusion), “fronting” and “kickbacks” are the forms of corruption most encountered. Government officials (as clients), contractors, and sub-contractors are perceived to be the parties most involved in corrupt activities. Forms of corruption most associated with government officials include the awarding of contracts for political gain, nepotism and conflicts of interest, and interference in the tender award process. Corruption is most prevalent during the bid evaluation and tendering phases of projects. Facilitating factors include a lack of transparency in the awarding of contracts and the operating environment of the industry. Barriers to reporting include a lack of confidence in the criminal justice system, a belief that no action will be taken, and a perception that ‘whistle-blowers’ are not adequately protected. Addressing the issues of corruption will require the inclusion of ethics topics in tertiary education and training curricula, special continuing development seminars provided by professional associations and industry bodies, tightening of building procurement procedures, and more forensic detection systems.

Keywords: corruption, mixed methods research, clients, construction professionals, South Africa.

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THE CASE FOR SLACK TO PROMOTE INNOVATIVE BEHAVIOUR IN CONSTRUCTION FIRMS

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The ability and willingness of individuals is a prerequisite to innovation. These traits are not unique to innovation in construction, but are universal amongst all innovative firms. Innovative behaviours depend on organisational resources and their deployment via managerial action. Organisational slack is forwarded as an enabler of innovation, as it makes a pool of unallocated resources available to connect ability to innovate and willingness to innovate. The authors posit that researchers and practitioners alike have failed to appreciate this enabler of innovative behaviour causing the principles of slack to be improperly overlooked. The case for slack resource allocation as a precursor to innovation is developed and the need to survey the attitudes towards slack organisational management held by construction organisations established. Institutionalism is identified as an analytical framework capable of explaining the interactions within the firm that differentiate between innovative and non-innovative construction organisations. A theoretical model of the role played by slack resource availability in stimulating innovative behaviours is developed for validation by a subsequent fieldwork programme.

Keywords: behaviour, innovation, organisational slack, organisational culture, resource management.

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CULTURE SHOCK OF ALLIANCE PROJECTS

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The Alliance procurement approach is used to stimulate collaborative working between project participants. When human resources are drawn from traditional project environments, the extent to which this is realized depends, in large part, on the ability of project participants to manage the shock of transition to a radically different organizational culture. Exploring the nature of this transition and individuals' experiences and coping mechanisms for dealing with it, we propose a theoretical model of culture shock, which helps to explain the transition process into alliance projects. We conclude that projects that recognise the culture shock that individuals experience are better equipped to manage 'non-alliance' behaviours and steer the right behaviours from these individuals to fit within the new culture.

Keywords: alliances, culture, culture shock, procurement, relational contracting.

A CASE STUDY OF THE IMPACT OF CULTURAL DIFFERENCES DURING A CONSTRUCTION PROJECT IN GHANA

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The lack of native engineers in developing countries means that often foreign engineers have a role to play in implementing the water and sanitation systems for rural communities as needed to meet the Millennium Development Goals targets for access to clean water and sanitation facilities. However, cultural differences between foreign engineers and local communities can lead to ineffective project management where these differences are not identified and managed successfully. A case study of a water and sanitation project undertaken in the Eastern Region of Ghana, with a British engineer and project manager, is used as the basis for exploration of some of the issues that arise when engineers work cross-culturally on this type of project. Hofstede's cultural dimensions are used as a conceptual paradigm through which to understand the behaviours and actions observed during the case study. The aim is to identify possible explanations for why cultural tensions arose during the project as a step towards understanding how these tensions might be reduced or eliminated in future projects in similar cultural contexts. It is found that cultural differences between engineer and community at the case study project led to issues with communication and implications for the effectiveness of different management structures. Findings may have broad relevance and help other engineers avoid some of the pitfalls of working in a cross-cultural context.

Keywords: culture, developing countries, Ghana, Hofstede.

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DO YOU FEEL WHAT I FEEL? EMPOWERMENT CONTAGION IN PROJECT TEAMS

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Psychological empowerment, described as constellation of experienced cognitions manifested as sense of meaning, competence, impact, and self-determination has been identified as an important motivating force in teams with performance consequences for individuals and teams. Prior research have therefore sort to identify factors from the individual-, team-, project- and organisation-levels that impact empowerment cognitions with the hope of providing concrete targets for promoting psychological empowerment. One constituency that has been overlooked is the likelihood that psychological empowerment in teams may be capable of being transmitted from one team member to another. This paper reports a study investigating whether psychological empowerment cognition in project teams is contagious. Using survey responses from 380 individuals, nested in 115 project management teams, we test the psychological empowerment contagion hypothesis using analysis of variance, interrater agreement and hierarchical linear modelling as proxies. Analysis of variance indicates that the between-team variance of team psychological empowerment is statistically significant and substantially larger than the within-team variance. Several measures of interrater agreement also show considerable agreement (consensus) within teams, further confirming the prevalence of psychological empowerment in teams. Team psychological empowerment also has a significant positive and independent impact on individual psychological empowerment, even after controlling for the impact of variables previously identified as influencing psychological empowerment. Team members who reported higher levels of team psychological empowerment were also more likely to experience higher levels of individual psychological empowerment themselves. Psychological empowerment is contagious and can be transmitted from one team member to another. These findings supplement the traditional sources of antecedents of empowerment and suggest that team members play an important multiplier role in engendering feelings of psychological empowerment both consciously and unconsciously.

Keywords: contagion, Hierarchical Linear Modelling (HLM), project team, psychological empowerment

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HUMAN RESOURCE MANAGEMENT AND SKILLS

ARCHITECTS IN SPAIN: A PROFESSION UNDER RISK

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A review of the literature reveals that Architecture as a profession has been already studied in countries which belong to the Anglo-American model of professionalization: Australia, Canada, the UK and the USA. However, there is a paucity of work with respect to the situation in Spain, a geographical context with specific cultural, social and economic features, which belongs to the Continental model of professionalism. The study of state-specific professions, taking into account cultural contexts, shows international similarities and variations, besides it informs about constraints and opportunities existing in our national systems. In an attempt to address this research gap, we aim to depict Spanish architects' experiences and concerns regarding work, career and professional life. An interpretive approach is used, within the qualitative paradigm, to analyse 38 semi-structured in-depth interviews with Spanish architects of different age, gender and employment setting. Open questions explored reasons for choosing the architectural profession, career drivers and obstacles, and the realities of their working lives. Findings show that although most rewards and stressors derived from the profession are similar among countries, the Spanish context has particular features which result in interesting differences. Families influence students when choosing a career in architecture, social capital is among the factors helping their careers the most, while women also identify as barriers other aspects related to gender and work-family balance. Due to the economic recession currently afflicting Spain, participants describe a rather discouraging description of their situation and outline the lack of prestige and status associated with the profession.

Keywords: architecture, diversity, professionalism, qualitative research, Spain.

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JOB SATISFACTION OF PROFESSIONALS WITHIN THE GHANAIAN CONSTRUCTION INDUSTRY

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Job satisfaction plays an important role in the overall productivity of any given industry. Despite its importance, little attention has been paid to white collared construction workers. This paper reports on a descriptive study that investigated the job satisfaction of construction based professionals within the Greater Accra Region in Ghana. Data was collected using a sample survey from 35 construction firms, 11 consulting firms, 2 client organisations, 3 management consultants and 5 construction management firms within the Ghanaian construction industry. Response data was subjected to descriptive statistics and subsequently ranking analysis were used to examine the relationship between age and job satisfaction. The results indicated that 'relationship with supervisor' and 'relationship with workmates' as the highly ranked factors leading to positive worker satisfaction whereas 'quality of life' and 'personal health' were the least ranked. The factors leading to negative job satisfaction were 'lack of motivation' and 'job dissatisfaction'. On the other hand, 'lack of alertness' and 'lack of confidence' were deemed to have minimum effect. The research limitation of this study is that the survey population consists of construction professions drawn from Greater Accra Region only; as such the findings may not be representative of all construction professions. The originality and value of this study is that little is known about the job satisfaction of the white-collared workers or construction professionals within the context of the Ghanaian construction industry. Given that the success and productivity of the construction industry is linked to the workforce and general 'quality of life', identification of factors affecting job satisfaction can therefore be used by construction organisations in shaping their human resources practices for construction professions. Furthermore, the results of this study can help management in general on how to minimise the negative job effects arising from lack of job satisfaction

Keywords: construction professions; job satisfaction; Ghana

HOW IS JOB SATISFACTION IN SPANISH BUILDING ENGINEERS INFLUENCED BY TRAINING?

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In business environments, training is one of the most important issues for human resource management. Through appropriate training, enterprises can rely on competent and motivated employees, ready to meet technological and strategic requirements. The aim of this study is to investigate training activities for building engineers developed by Spanish construction companies. But it also aims at analysing the effect of training on job satisfaction. A qualitative methodology has been applied, by means of semi-structured interviews to 34 building engineers. ATLAS-ti software has been used for the analysis of the interview contents. Findings reveal that, with the exception of a large company, no planned training has been developed in order to satisfy building engineers' needs. If any, there is initial training for management systems, as well compulsory training on risk prevention. Additionally, most engineers follow their own training courses, in order to update knowledge or improve promotion opportunities. Finally, the effect of training on job satisfaction tends to be positive, with increasing effects when it improves work post performance.

Keywords: human resource management, job satisfaction, qualitative research, training.

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THE SOCIALISATION OF OUTSOURCED EMPLOYEES IN FACILITIES MANAGEMENT: A RESEARCH AGENDA

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There have been several attempts made to understand organisational socialisation in the wider construction industry, but there is a paucity of related research in the FM field. Little research has established the degree of congruence between outsourced employees and the FM companies they work for, and the part they play in the delivery of organisational goals and objectives. Today's outsourced employees are not always aware of the important role they play in service delivery and are not typically socialised by either the service provider or the client organisation. Socialisation can help them make this connection. This will increase the opportunities of service providers and clients to maximise the productivity of the employee in achieving their major aim as a company – customer satisfaction. There is an exploration of the concept: 'FM cultural fit' which is the ability of outsourced employees to integrate into the organisational culture of the client organisation. 'FM cultural fit' is important to ensure that outsourced employees are able to understand the client organisation and deliver on their company goals in addition to fulfilling the terms of their contract. It is a concept based on the application of organisational culture and socialisation theory to FM. This agenda details the important factors and forms the basis of a larger research project, so the methodology only shows the expected process before data is collected. The agenda establishes the dynamics that exist between the four interwoven players (service provider, the client, the employee and the customer) and how these relationships affect/effect efficient service delivery and customer satisfaction. It also shows the importance of an organisational socialisation process for contracted staff to enable them deliver at maximum capability.

Keywords: customer satisfaction, facilities management, organisational culture, organisational socialisation, service delivery.

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IMPROVING PROJECT PERFORMANCE THROUGH WORKER PARTICIPATION IN ALLIANCE PROJECTS

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Worker participation has a direct influence on construction project performance and is a major factor of productivity in construction. Alliance principles emphasise the significance of developing a culture for innovation with worker participation. Therefore, this study identifies the existing worker participation practices and their limitations in a typical alliance project. The study uses the case study approach with semi-structured interviews with alliance management and a questionnaire survey with middle level management to assess their perceptions on worker participation. The study reveals that regular worker performance appraisals, worker training and provision of project performance information to workers are important worker participation practices required in an alliance project. The way project teams are acknowledged and rewarded to increase participation also appears to be an area that considering the selected case study project can be developed further. In addition it would seem advantageous for the project to build worker participation practices from the very beginning rather than midway through a project.

Keywords: alliance project, bottom-up approach, case study, worker participation.

**INTER-ORGANISATIONAL RELATIONS AND SUPPLY CHAIN
MANAGEMENT**

LEARNING HOW TO EAT AN ELEPHANT: IMPLEMENTING SUPPLY CHAIN MANAGEMENT PRINCIPLES

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There have been a range of calls for the construction industry to address perceived structural failings and adopt supply chain management best practice models. However, many studies in the construction sector report poor uptake. A possible reason for this is a failure of companies to implement their supply chain improvement programmes effectively. Such changes may involve companies adopting new approaches, new processes and new ways of working. In order to manage this daunting undertaking, the role of managing new knowledge and sequencing activities is important. Hence, the purpose of this paper is to investigate the anatomy of a long term supply chain improvement programme in the construction industry. Building on established supply chain management principles, and models of supply chain learning, a longitudinal case study is analysed. Insight is given into the role of learning and the sequencing of activities. The paper contributes by refining established supply chain management frameworks.

Keywords: supply chain management, learning organisation, sequencing, implementation, change management.

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KNOWLEDGE TRANSFER WITHIN AND ACROSS ORGANIZATIONAL BOUNDARIES -A CASE STUDY IN THE CONSTRUCTION INDUSTRY

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Knowledge transfer is essential for an organization to be competitive and successful. However, as projects are temporary, knowledge is often bound to the individuals in projects rather than to the core organizations. The main research question for this article is: *How can collaboration be used in order to transfer knowledge from one project to another within an organization or with other organizations within a project?* To do this, a theoretical framework of recent literature concerning knowledge management and transfer is used, as well as a case study about an urban development organization working with a rather unique collaboration structure in order to maximize the knowledge transfer from and between different actors. Our method of research has been interviews with a divisional manager and two project managers at an urban development organization. Results from our case study indicate that in the planning phase, knowledge transfer includes collecting feedback and information as well as using a central knowledge platform. During the production phase, face-to-face communication is the most important form of knowledge transfer. After each project, evaluation is essential to collect the experience of collaboration and identify planning errors. Our findings also show that most knowledge transfer occurs at an informal level. The study concludes that several factors affect knowledge transfer in a construction organization. The most essential are the media in which knowledge is transferred and the way information is stored. Taking all factors into consideration, an organization with a decentralized structure and an open and broad-minded culture enables successful knowledge transfer.

Keywords: construction industry, knowledge objects, knowledge transfer, learning boundaries, project organizations.

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DESIGNING A DYNAMIC NETWORK BASED APPROACH FOR ASSET MANAGEMENT ACTIVITIES

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Transportation networks are important public infrastructures because they enable economic and social activity. Trends in contracting the maintenance of such assets have caused a shift in governance from a public body to market-like arrangements and changed the roles and responsibilities among asset owner, asset manager and service providers. Basic assumption of this research is that collaboration between contractors in road infrastructure is needed and can be stimulated through facilitating joint coordination on a network level, based on a social costs incentive. Based on a literature review design components and possible techniques are identified. Then the concept design and testing methods for a dynamic network-based tool to facilitate strategic infrastructure asset management is proposed.

Keywords: asset management, collaboration, procurement, scheduling, serious gaming.

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INFLUENCE OF THE MACRO-ECONOMY ON TRUST IN CONSTRUCTION SUPPLY CHAIN CHAINS

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It has often been claimed that developing trustful relationships across the construction supply chain is likely to yield higher project performance outcomes. However, most recently, it has been suggested that there seems to be an apparent retreat by some of the earlier advocates of the relational agenda through trust development given the economic turbulence. Such claims raise important questions regarding the influence of macroeconomic factors/environment on relationship-based approaches and hence trust development. Was the promotion of such relational agenda purely driven by the burgeoning economy as claimed by some at the time or was this the right direction for the construction industry if higher project performance outcomes were to be delivered to clients? This study aims to explore from literature, the current state of the relational agenda in the UK construction industry with particular emphasis on trust development so as to gain an insight into what the future outlook is likely to be. Literature on trust in construction and other team-based industries are synthesised to identify any links between trust development and themes that relate to or can be influenced by the macro-economy. From this, it is argued that perhaps, the macroeconomic environment exerts a considerable influence on trust. There is a higher tendency for firms to display higher levels of competence trust and relatively lower levels of integrity trust during economic downturns. For high levels of project performance to be maintained, clients may switch between different governance modes underpinned by 'collaborations with and without integrity trust' depending on the project life cycle and macro-economic outlook. This could influence overall procurement and managerial strategies on projects such that the use of transactional approaches could become more prominent during periods of economic downturn.

Keywords: macro-economy, construction supply chains, Trust.

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A CONCEPTUAL MODEL FOR CONSTRUCTION SUPPLY CHAIN MANAGEMENT IMPLEMENTATION

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During the last two decades, both researchers and governmental studies revealed an increased interest about Construction Supply Chain Management (CSCM), but up to now practitioners are still facing difficulty to improve business performance through such approach. A call for ad-hoc solutions that foster the effective implementation of SCM practices has clearly risen up. This working paper is part of a wider research project which aims to provide academics and practitioners with a valuable support in this direction. We propose an integrated conceptual model to enhance the implementation of CSCM from a contingent view. The research to date includes an extensive and systematic literature review that assesses the main building elements related to SCM introduction. Such elements include: the antecedents, or prerequisites; the approaches, which involve the interrelation of strategies, structure and practices; the benefits related to an effective SCM adoption; and the contextual and environmental variables. Main implications for academics concern the analysis of extant CSCM literature from an innovative and integrated perspective, in order to highlight actual research gaps and future research agenda. At this research stage, other important goals include the advancement of useful and challenging research questions and hypothesis, with the aim to collect relevant feedback about the suitability of both the model and the research strategy.

Keywords: antecedents, conceptual model, contingent approach, supply chain management.

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COLLABORATIVE SUPPLY CHAIN PRACTICES DURING SEVERE ECONOMIC DOWNTURN IN THE REPUBLIC OF IRELAND

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Construction in the Republic of Ireland held a dominant position in the economy in the decade to 2007, at peak accounting for 24% of GDP. Given the scale of this contribution it is clear that leveraging even modest efficiencies in the supply chain could yield significant benefits. Recent literature in the field of construction supply chain management suggests such collaboration is far more difficult to achieve in times of austerity. Post 2007 the industry suffered a spectacular decline, a collapsing property bubble, exasperated by the world economic downturn in 2008 led to a circa 75% decline in output. A study commenced in 2011 to investigate the extent and nature of supply chain management practices in the industry and to record the impact of the prevailing austerity. A review of relevant literature showed a significant deficit of information pertaining to the Irish industry. As a consequence of this an exploratory questionnaire survey was undertaken to collect data on supply chain management attitudes and practices in the industry to inform and scope future research strands. The results indicate a high degree of understanding of supply chain concepts and strong industry support for collaborative supply chain management approaches. Respondents also have a reasonably clear grasp of the potential of collaborative approaches and the barriers that militate against its wider use. The survey results is compared to previous results from the UK, supporting the general conclusion of an increased focus on 'cost' related supply chain factors in Ireland at present. The generally supportive results of the survey towards collaborative approaches are also compared with evidence that suggests the industry is engaging in widespread opportunistic behaviours such as below cost tendering, claims and late payment that are contrary to collaborative approaches. This prompts the further conclusion that the industry is not practicing what it preaches.

Keywords: austerity, collaboration, Republic of Ireland, supply chain management

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TRUST, CONTROL AND KNOWLEDGE INTEGRATION IN A ROCK TUNNEL PROJECT

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Rock tunnel projects that experience geological uncertainties tend to be both lengthier and more costly than planned. Traditional contract arrangements have proved to be less suitable when uncertainty is high; problem-solving being further hampered by contract-related distrust, communication failures and disputes. To efficiently respond to uncertainty and control risks of time and cost overruns, the knowledge of specialists in different firms needs to be mobilized. Findings from a case study of a railway tunnel project in Sweden aim to describe knowledge integration, communication and decision making related to geological conditions, comprising both formal and informal aspects. Findings show that formal and informal aspects are often complementary, also when they are contradictory, but that knowledge integration may suffer from a more formalized communication. Further, it is also important to consider relationships within the main actors' organizations as well as relationships and structures extending beyond the individual project.

Keywords: communication, control, knowledge management, relational contracting

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IMPROVING SUPPLIER RELATIONSHIP MANAGEMENT WITHIN THE AEC SECTOR

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Due to changes in many facets of projects and organisations, relationships between firms in the delivery of construction projects have consequently become more critical for the success of the project. Whether it is a transactional exchange or series of transactions spread over a period of time, relationships need to be managed. However, the concept of managing supply chains and relationships between firms has been relatively new to construction industry. Early pioneers of the concept, primarily automotive, aerospace and manufacturing industries, have greatly benefitted from non-adversarial, long-term and collaborative relationships. Although contextual factors within those industries largely shape each industry's approach to SCM (Supply Chain Management), its application within the AEC industry is slowly beginning to appear in a distinct shape and form. Through a comprehensive review of literature on construction-specific SCM (cSCM), the study has identified that partnering, collaboration and trust are the three most prominent variables within the cSCM literature. Partnering and collaboration are considered to be relationship management tools, whereas trust is identified as the most significant relationship facilitator. In spite of its significance on relationship development, there is very limited research carried out on the trust aspect of relationships. By understanding how trust is built and maintained, and what the conditions that result in mistrust are, firms can better manage their supply chains and their relationships with firms in the supply chains, manage factors that result in mistrust and mitigate potential conflicts arising from mistrust. Consequently this will facilitate better collaboration, result in high-level of commitment, improve project teambuilding, and avoid conflict and adversarial relationships. Drawing on organisational relationship management literature, we argue that trust must be approached from five dimensions; economic, social, psychological, inter-personal and organisational. These dimensions are unidirectional and they must be accounted conjointly as they are interrelated and interdependent.

Keywords: supply chain management, relationships, trust, partnering, collaboration.

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PRE-SELECTION OF CONSTRUCTION CONSULTANTS BASED ON ATTRIBUTES OF TRUST

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A review of construction consultants' selection identified weaknesses in the process that focused on cost and technical abilities alone. This paper presents a construction consultant pre-selection factor model based on attributes of trust, which attempts to improve consultant selection processes. A review of related literature shows that trust was found to enhance the decision making process. However, there is a knowledge gap in construction management literature as regards what constitute the attributes of trust which can be of benefit to the construction client or its agent in selecting appropriate consultants. In total 37 consultant selection trust attributes thought to potentially influence consultant pre-selection were identified from literature. Based on these attributes, a structured questionnaire survey was designed using a Likert-type scale and administered online to 189 willing construction clients. Survey responses were analysed using principal component analysis. This led to the development of an 8-factor model of consultant pre selection, namely, (1) service quality, (2) collaborative relationships, (3) qualification, (4) organisational trust, (5) personal qualities, (6) ability, (7) experience and (8) respect. The research provides the construction industry clients with a practical 8-factor pre selection model that can be effectively used by the construction clients to improve the consultant selection process.

Keywords: consultant selection, pre-selection, principal component analysis, trust.

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ROLE CONFLICT AND ROLE AMBIGUITY IN CONSTRUCTION PROJECTS

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Role conflict happens when a person faces different and incompatible expectations regarding a particular social status which they occupy. The literature on role conflict is reviewed for a better understanding of project dynamics in construction teams. The discussion focuses on issues surrounding the miscommunication of role expectations and tensions owing to differences in expectations of the same role. This ongoing doctoral study involves a qualitative research design, based on interviews with practicing professionals. Analysis will focus on the relation between formal expectations, as evidenced in contracts and other types of written communication, and informal expectations as observed from the interviews. Insights from the literature review suggest: 1. that the differences between formal and informal expectations is a major sources of role conflict in construction teams and 2. that this effect is exacerbated by the failure of team members to recognise it and take it into account.

Keywords: contract, organizational behaviour, project dynamics, role conflict.

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OFFSITE CONSTRUCTION

RE-ENGINEERING THE CONSTRUCTION SUPPLY CHAIN: TRANSFERRING ON-SITE ACTIVITY, OFF-SITE

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Interest in supply chain management theory and practice in UK construction has grown considerably over the past decade. In parallel, a number of other key industry initiatives have also gained momentum. A notable development has been the increasing modularization of the construction process. The theoretical merits of off-site manufacture in construction are well documented and include reported benefits in production, scheduling and quality improvements. However, the impact of modularization on the governance and membership of the construction supply chain are less well-known. In an effort to connect supply chain management theory with modern methods of construction (MMC), the research investigates the potential impact transferring on-site activity, off-site will have on the supply chain. This is a conceptual paper based primarily on a review of supply chain management and MMC literature. Drawing on supply chain management theory and practice, the significance of an increasingly modular-orientated supply chain in construction is explored and evaluated. Secondary data is provided via anecdotal evidence gathered from a number of construction site visits and discussions with a cross-section of industry stakeholders. The adoption of modular construction and subsequent transfer of traditional on-site construction activities off-site is likely to necessitate a re-engineering of current construction supply chain management practice. In contrast to the commercially biased supply networks reflective of long-established working practices, off-site modular construction is likely to engender supply chain relationships that are increasingly socially as well as technologically bound and influenced by changes to the power dynamics. The literature highlights many business related opportunities, however the transfer of traditional construction activities upstream is not without risk. In conclusion, the research provides a conceptual grounding for further investigation of modular construction and the potential impact on the management and structure of construction supply chains.

Keywords: supply chain management, power, trust, relationships.

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BARRIERS AND DRIVERS FOR INCREASED USE OF OFF-SITE BRIDGE CONSTRUCTION IN SWEDEN

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There is great pressure to change the civil engineering industry in Sweden, which is said not to follow efficiency growth other manufacturing sectors are achieving. This increases a demand for innovative construction methods and a growing industrialised thinking for sustainable construction. By implementing off-site manufacturing (OSM) into bridge construction, client satisfaction can increase, bridges can be constructed faster using less resource, and more bridges for the same invested capital can be realised. A questionnaire survey and a workshop have been undertaken partly to identify benefits and drawbacks for OSM in bridge construction and partly to study if OSM satisfies the client better than on-site construction. The outcome shows that drivers of OSM meet client needs better than on-site construction alternatives. Time, cost and working environment are large drivers, correlating well with previous surveys undertaken. However, quality, as in other surveys tend to stand out as a driver, is a barrier in comparison with on-site construction. This opinion may be due to both the generally negative views for OSM bridges in Sweden and also due to previous bad experiences. Despite these negative views, results show that the hypothesis of OSM being a better alternative for satisfying the client is true. To increase its market share, barriers like reduced quality and not aesthetically pleasing must be overcome. OSM bridges are to date a rare feature in Sweden, but by displaying the drivers, it could become a common construction method in Sweden.

Keywords: off-site manufacturing (OSM), bridge construction, client needs, barriers, drivers.

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IDENTIFICATION AND REDUCTION OF NON-VALUE ADDING ACTIVITIES IN THE PRECAST CONCRETE CONSTRUCTION PROJECTS IN SINGAPORE

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Prefabrication systems are believed to have the potential for better environmental performance and have been adopted by the construction industry to meet the challenges posed by global climate change. However, there remains many areas in the prefabrication systems that can be improved in order to reduce carbon emissions, such as site layout, work flow and inventory control. This research therefore aims to identify the non-value adding activities that can be eliminated to reduce carbon emissions in the precast concrete construction projects in Singapore. A weighted factor model comprising 30 contractors in the Singapore construction industry is adopted. Two stages in the precast concrete installation cycle are investigated using the weighted factor model, which are site layout management and delivery management. The results indicate that there are many non-value adding activities in the precast concrete installation cycle that contribute to an increase in the level of carbon emissions, such as large storage area and lack of just-in-time sourcing. The analysis provides good practice guidance and can be used as a checklist for contractors to achieve low-carbon installation. The results will also be useful for regulatory agencies to provide recommendations for the construction industry to reduce carbon emissions.

Keywords: carbon emissions, non-value adding activities, prefabrication, sustainability.

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INTERFACE MANAGEMENT FROM AN OFFSITE CONSTRUCTION PERSPECTIVE

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This paper is the subject of an ongoing PhD study with the primary research question: what is the relationship between offsite and interface management? While interface management takes many forms, the focus of this study has been organisational interface management to determine the various process and people factors, which have an effect on efficiency. The literature on offsite construction has been analysed to determine the relationship of the process and people factors identified. The changing nature of the construction process to a more specialist sub-contractor format has created new problems in the management of interfaces, none more so than the interfaces that have emerged from the offsite production and onsite incorporation of bathroom construction. The focus of the research is to determine a pragmatic framework of the main process and people factors which have an impact on the interface management of offsite and onsite forms of bathrooms/wet rooms. This paper includes a summary of a literature review on offsite and interface management. A pilot study using semi-structured interviews was carried out with six academics and industry practitioners to gauge the validity of the questions and the relevance of the 16 factors. The data gained from the pilot study was analysed using a five point Likert scale. This paper focuses on the process factor of design management and the people factor of communication. The results from the small sample clearly indicate the importance of early engagement of the contractor in the design process and that open communication between all stakeholders is essential to resolving organisational interfaces issues. The results of this study have also confirmed that the management of interfaces are of equal, if not more importance when incorporating offsite forms of bathroom construction into the construction process. In conclusion further research is required to determine the main factors, which will impact on successful organisational interface management.

Keywords: interface management, offsite construction, people factors, process factors.

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ORGANISATIONAL STRATEGY AND BUSINESS PERFORMANCE

PRO-INNOVATION BIAS IN CONSTRUCTION- ENABLERS AND RISKS

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The term innovation has become ubiquitous in modern business and political circles in recent years. Innovation is increasingly seen as essential for commercial success and as a means to increase living standards, competitiveness and productivity in a world of depleting resources. By thinking more creatively about the risks and opportunities they face, it is argued widely that individuals, organisations and nations can get ahead of their competitors. But is innovation always positive and what are the enablers of innovation which determine its success? We explored these questions through interviews and focus groups with thirty thought leaders in the UK construction sector. From our analysis we conclude that there are four main enablers of innovation in the construction sector, namely: collaboration, regulation, skills, education and research and, leadership. Recommendations are made to capitalize on them.

Keywords: innovation, bias, risk, barriers, enablers.

VALUE MANAGEMENT IN INFRASTRUCTURE PROJECTS IN WESTERN AUSTRALIA: TECHNIQUES AND STAGING

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Infrastructure projects to service the mining industry in Western Australia (WA) are on the increase, somewhat in contrast to a stalling of projects nationally and globally. It remains important therefore for WA companies to be competitive in the realisation of a client's brief. Value management (VM) has long been regarded as an effective means to eliminate unnecessary capital and life-cycle costs, however, whilst many are familiar with the underlying theory, its use locally is perceived to be less widespread. The research presented here investigates the extent to which value management is implemented by Western Australian engineering and construction companies in both the design and construction fields; exploring, the various value management techniques used in practice and, VM staging. This study documents benefits achieved by means of value management and, the attitudes of industry professionals towards the feasibility or need in establishing a compulsory value management procedure for all (civil engineering) developments. To investigate current value management implementation in WA a pilot-study research methodology embraced a qualitative semi-structured interview approach of ten respondents from organisations involved in design and construction of civil engineering work. Straw poll project results suggest WA industry to be well aware of both, the concept of value management and, the benefits that may arise from its use to address the life-cycle of a project; case-study specification analysis is then presented to explore VM benefits/disbenefits explicitly. The research presented here concludes that industry does have formal value management procedures within a preliminary design phase. Findings show however that industry is resistant to a statutory requirement for value management and, argue that in WA competition is enough to drive the uptake and utilisation of VM.

Keywords: value management/engineering, design-specification, Western-Australia.

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A CRITICAL REVIEW OF PMS IN CONSTRUCTION: TOWARDS A RESEARCH AGENDA

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Performance measurement system (PMS) is a fast evolving and diverse research field attracting many researchers and practitioners from the fields of strategy, accounting, operations, human resource, and marketing. The characteristics of the construction industry that influence the research and directions adopted in practice significantly contribute to certain weaknesses in application, such as limited focus on business performance measurement, insufficient organisational learning, and difficulty in linking the project PMS with the firm. The *aim* of this paper is to briefly review the literature of PMS (specifically at the corporate level) for addressing the knowledge gap and presenting a research agenda in the context of construction. The main findings from this review are: (1) the evolution of PMS in construction management literature is much slow; (2) further research should focus on the design and implementation related issues of PMS in construction; and (3) benchmarking is an integral part of PMS but it is insufficient for 'continuous improvement'. Finally, a research agenda is presented.

Keywords: performance measurement system, PMS, benchmarking, strategy, firm performance

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CORPORATE ENTREPRENEURSHIP FOR CONTRACTING COMPANIES: THE CURRENT ISSUES

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Entrepreneurship has recently received major attention from many business practitioners and scholars and evolved rapidly in many industries. Due to the project based nature, high competition and business risk characteristics of the construction industry, entrepreneurship is considered very important for sustaining and improving the performance of contractors. An extensive literature review on entrepreneurship, with a particular focus on the implementation of corporate entrepreneurship by contractors, has been carried out. It was found that corporate entrepreneurship is defined by many characteristics. This study adopted the characteristics which are grouped into five categories: innovativeness, risk-taking, competitive aggressiveness, pro-activeness, and autonomy (Lumpkin and Dess, 1996). There is very little research focusing on entrepreneurship in the construction industry, exploring those characteristics together. So far, researches in construction management have only been carried out in innovativeness, risk taking and competitive aggressiveness individually. This study, as part of doctoral study, is aimed at clarifying the entrepreneurship concept and presents a theoretical framework to investigate entrepreneurship in construction in a systematic way in order to illuminate further studies that will investigate the relationships between each characteristic and to explore the outcomes of different combinations of these characteristics in terms of corporate strategies.

Keywords: corporate strategy, contractors, entrepreneurship.

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MANAGING THE PERFORMING PARADOX IN ARCHITECTURAL COMPETITIONS

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In architecture competitions are fascinating. Over the years, they have increasingly become a popular mechanism for architects in acquiring work and clients in looking for designers. Still they are a debated topic presenting several controversial issues. In fact, competitions, as architecture in general, are a fertile ground for contradictions and management oxymora struggling among opposing forces, such as artistic recognition and market constraints, individual passion and collective collaboration, creative spark and discipline. These are actually examples of paradoxes that architects confront regularly. In organizational terms, a paradox is a set of contradictory yet interrelated elements, logical in isolation but irrational when juxtaposed. Paradoxical tensions exist simultaneously and persist over time with no resolution, therefore attending competing tensions is critical for architectural practices. Through an inductive qualitative case based research, this paper explores why a performing paradox exists within architectural competitions, what tensions are experienced and how they are managed.

Keywords: architecture, architectural competitions, paradoxes, performance, practice management.

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TOWARDS THE IDENTIFICATION OF FACTORS AFFECTING THE DEVELOPMENT OF SMALL SIZED CONSTRUCTION CONTACTING ORGANISATIONS

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The UK construction industry is characterised by its fragmentation into large numbers of small sized construction contracting organisations. Previous data has indicated a record of failure of such construction based enterprises especially in times of economic recession. A study has been conducted with small sized construction contracting organisations in order to explore the pertinent factors found to affect their survival and/or growth. The participants in the study were selected from the University of Salford's Leading Enterprise and Development (LEAD) programme, which seeks to promote successful companies in business. The study was conducted from an interpretative perspective using a qualitative approach. Six in-depth semi-structured interviews have been conducted with key players in commercial/residential construction contracting organisations including the owners of two failed businesses. The methodology adopted allowed the generation of "insider accounts" that provided rich deep contextual data. From the interviewed participants, a number of factors have emerged that have been classified under the headings of service orientation; supply-chain; quality benchmarking; trading period; critical self assessment; specialist service; employment status; local links to community and inadequate control measures. Further data analysis and comparison with factors identified from literature allowed an initial conceptual framework of factors thought to aid the development of small sized construction contracting organisations SCCOs. The framework provides the basis of further data collection so as to ensure greater robustness of the emergent framework.

Keywords: small sized firms; development, growth.

THE ACTORS AND THEIR ROLES IN THE MEANING MAKING PROCESS OF AN ENERGY TARGET

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How are new long-term energy targets for buildings managed in public construction client organisations? This paper presents an empirical account of the actors, their roles and contributions to the meaning making process regarding an energy target for public buildings and the development of an energy strategy. With this account, we wish to initiate a discussion on what actors and practices that are needed in construction sector when contextualising and implementing long-term energy targets in practice. The paper is based on a longitudinal study in a public construction client organisation in Sweden, where for example in-depth interviews and observations of meetings has been used for data gathering.

Keywords: actors, energy target, meaning making process, strategy development process, public construction client.

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MANAGING CHANGE THROUGH PARTICIPATION: DEVELOPING SHARED CONSTRUCTION GUIDELINES IN 26 PUBLIC ORGANISATIONS

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Increasingly public sector clients are being asked to do more for less and are pushed to achieve higher levels of transparency and accountability. Thus, organisations' ability to address challenges like these has become increasingly important. As a result, a range of models have emerged to help organisations successfully manage this development. The research presented in this paper draws on an exploratory case study of an ongoing change process in the City of Gothenburg, where 26 municipal organisations are developing a shared process (Shared Construction Guidelines) for how to conduct building and infrastructure projects in the City. The aim is to describe this case of participatory change and to shed light on its complexities. Findings show that there is a high degree of commitment and participation in the case of Shared Construction Guidelines. However, there seems to be a gap between top management and the rest of the change organisation and resources are limited, especially in terms of time. Also, several findings indicate challenges regarding the understanding of the change. Altogether, this might explain why all members do not feel that they can fully affect the process, even though it is based on broad participation. Finally it is highlighted how the existing literature on change management falls short when describing complex participatory change processes.

Keywords: change management, organisational change, participation, shared processes.

PROCUREMENT

UNDERSTANDING EARLY CONTRACTOR INVOLVEMENT (ECI) PROCUREMENT FORMS

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It is widely accepted that contractors have much potential valuable advice to offer at the front-end of project development. This concept is sometimes called early contractor involvement (ECI) and encompasses various relationship-based project procurement (RBP) forms. These are currently being globally adopted and adapted and at times this results in misunderstanding of the finer grained nuances between the forms. This often results in participants having unrealistic expectations of team behaviours and relationships between project parties, particularly what is expected of the project manager and lead sponsor accountable for project delivery. Unrealistic expectations may trigger perceived project failure. This lack of understanding of behavioural expectations of ECI form inhibits those who deliver projects from performing to expectation. Clients choosing an ECI project procurement form would benefit from a clearer definition of behavioural expectations. This paper attempts to set a conceptual behavioural framework for ECI that helps us better establish a way of understanding what ECI and RBP procurement forms offer.

Keywords: project alliances, ECI, relationship-based procurement.

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A PROCESS ACCOUNT OF CONSTRUCTION MEDIATION

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This paper seeks to argue that construction mediation has hitherto been viewed and evaluated in a relatively narrow fashion. It suggests that whilst there are numerous and well-known benefits to the process, although these are not always accepted by all academics or practitioners, in such things as the speed of the potential settlement and lower cost implications there are other valuable benefits, benefits that tend not to be considered but have real value. The central claim is that construction mediation has the potential to become a transformative process. It argues that greater emphasis ought to be placed on the 'process' of dispute resolution and the attendant benefits that can result in the construction professional undergoing a developmental and maturing experience through engagement with mediation. These benefits ought to be then considered alongside other, more traditional accounts, of the strengths and weaknesses of mediation. The argument will be developed through reference to currently recognised models of mediation. It will conclude that through the use of mediation in dispute resolution the construction professional can develop both a range of important attributes such as more developed communication skills as well as important mental and social attitudes that can engender empowerment and may serve as an aid to cultural change in the industry.

Keywords: mediation, education, professional practice, transformation.

A PRELIMINARY METHOD OF CLASSIFYING COLLABORATIVE CONTRACTUAL BEHAVIOUR IN HIGHER EDUCATION CONSTRUCTION PROJECTS

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The Browne review combined with the current economic conditions has provided a catalyst for change in the funding arrangement, for the higher education sector in the United Kingdom (UK). Consequently, Institutions will place a greater focus on their supply chain to offer services that best fit their requirements, during the construction and refurbishment of their physical assets. The construction industry will need to offer innovation, value for money and other benefits associated with the collaborative procurement movement, which has been gathering pace since the 1990s. This has resulted in the insertion of a multitude of collaborative features into construction contracts. Literature explored in the paper relates to collaboration and its associated contractual procedures. Reflective practice in the higher education estates and property sector relates the literature to real life experience of primary supplier side stakeholders. The research uses a postmodern philosophical paradigm that expands the existing knowledge base using an inductive approach; and a case study strategy with its foundations in an ethnographic study of lived experiences over a cross sectional time horizon. The data source comprises of three interviews with senior management that have independent viewpoints of the same socially constructed artefact. The data's narrative identifies mixed perceptions when it comes to contractual mechanisms achieving their desired benefits. The deliverable of the research is a preliminary method to classify and select contractual mechanisms based on three-dimensional reasoning in relation to risk, motivation and implementation. The value of the research is in the method it provides, which will facilitate further research into the perceived appropriateness of contractual procedures.

Keywords: collaboration, procurement, contracts.

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MULTINATIONAL CONTRACTING INTO AUSTRALIA: DEVELOPING DUNNING'S THEORY AND CASE STUDY DESIGN

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In response to the need to leverage private finance and the lack of competition in some parts of the Australian public sector infrastructure market, the Australian Federal government has demonstrated its desire to attract new sources of in-bound foreign direct investment (FDI) by multinational contractors. This study aims to update progress towards an investigation into the determinants of multinational contractors' willingness to bid for Australian public sector major road and bridges. This research deploys Dunning's eclectic theory for the first time in terms of in-bound FDI by multinational contractors into Australia. Elsewhere, the authors have developed Dunning's principal hypothesis to suit the context of this research and to address a weakness arising in this hypothesis that is based on a nominal (yes or no) approach to the ownership, location and internalisation (OLI) factors in Dunning's eclectic framework and which fails to speak to the relative explanatory power of these factors. The authors have completed a first stage test of this development of Dunning's hypothesis based on publically available secondary data, in which it was concluded tentatively that the location factor appears to have the greatest explanatory power. This paper aims to present, for the first time, a further and novel development of the operation of Dunning's OLI factors within the context of multinational contracting, as well as a preview of the design and planned analysis of the next empirical stage in this research concerning case studies. Finally, and beyond the theoretical contributions expected, other expected contributions are mentioned concerning research method and practical implications.

Keywords: case study design, Dunning's eclectic paradigm, multinational contracting.

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PROBABILISTIC PRE-REQUISITES CONTRIBUTING TO SUCCESSFUL HOUSING ASSOCIATION PARTNERING

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The achievement of value for money has been paramount during the current economic climate. The reduction in investment into social housing projects has forced Housing Associations to further minimise waste and pursue the maximisation of value. The success of the continually endorsed utilisation of partnering arrangements to produce value for money is dependent upon the implementation of various pre-requisites. An in depth critical analysis was therefore undertaken to identify these necessary pre-requisites that facilitate a successful partnering outcome. This paper forms part of a wider research and provides a thorough review of the industry perceived pre-requisites to facilitate a successful partnering arrangement. This will enable an empirical assessment of the level of importance placed specifically by Housing Associations on the reviewed factors in future research and in the process contributes to a conceptual model for effective Housing Association partnering arrangements, however the model has not been considered in this paper. It is envisaged that the wider research, upon which this paper is based, will assist Housing Associations maximise value for money by increasing the likelihood of a successful partnering outcome through gaining an understanding of the most important pre-requisites to be implemented into the arrangement from a Housing Association perspective. It is also expected that this research will enable the differentiation between the most and least important pre-requisites identified within the literature, thus clarifying the necessary factors for Housing Associations to implement.

Keywords: housing associations, partnering, pre-requisites, procurement.

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HOUSING ASSOCIATION PREFERRED FORM OF PARTNERING

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Partnering has been implemented by many Housing Associations as the procurement arrangement to maximise value. There are two dominant forms of partnering being utilised, namely strategic and project partnering. The ethos of strategic partnering is long term collaborative working for a series of projects, as opposed to project partnering, based on short term collaboration. There are conflicting views on the appropriateness of each form of partnering and the value that can be achieved. This creates ambiguities for Housing Associations when attempting to implement a partnering arrangement, who may be confronted by a dichotomy between long term value and short-term savings induced by market prices. The form of partnering currently implemented by Housing Associations must be identified. Distinguishing between each form of partnering and the rationale for selection will assist Housing Associations with their decision-making process to implement the appropriate form. The methodology adopted was a fusion between quantitative and qualitative fieldwork. This integrated the numerical data for the frequency of use and the conducted interviews to achieve an understanding of the reasons for selection. Furthermore guidance has been provided to Housing Associations on the form of partnering being implemented within their sector and the perceived benefits that can be achieved. The findings unveiled that the strategic form of partnering is the preferred arrangement for Housing Associations due to the longer term benefits being achieved through continuity of relationships.

Keywords: housing associations, partnering, procurement, project, strategic.

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HOW TO PROPORTION CAPABILITY AND FEE PERCENTAGE FOR TEAM COMPARISON IN COMPETITIVE EARLY INVOLVEMENT

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Early involvement of the construction team is increasingly utilized in challenging projects to incorporate versatile expertise in their planning. For public owners this is a challenge since they are obliged to use competitive, transparent team selection based on the ‘most economically advantageous criterion’ which ensures that both price and quality viewpoints are taken into account. In the case of early involvement, the price component naturally does not include the total price, but may consist only of the fees of competing service providers. This study examines such a selection situation and seeks to find a way to integrate the fee component in a multi-criteria selection system and determine reasonable fees for different levels of capabilities. The study builds on the productivity difference between different competences, derived from a survey of practitioners, and determines an indifference curve arithmetically for the planning of a selection method. The influence of the owner’s risk attitude and risk premiums are also taken into account based on the pricing methods of the theory of finance.

Keywords: alliancing, early involvement, contractor selection, partnering, procurement.

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UNDERSTANDING POST-CONTRACT CHANGES IN PARTNERING PROJECTS: AN ETHNOGRAPHIC APPROACH

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Partnering continues to be widely used in the UK. However, the partnering literature often presents polarised views of reality, which has stunted our understanding of the enactment of partnering as an informal and emergent practice. Power permeates social interactions and potentially affects partnering relationships in ways that contradict best practice guidance. However, understandings of power in partnering projects are limited. Post-contract changes (PCCs) are a common source of conflict on projects around which to explore interactions. Power relations and interactions are embedded practices that must be understood within the context of the project. Therefore, the aim is to adopt an ethnographic approach to explore how individuals interact on projects when managing PCCs and to explore how power affects these interactions. As part of ongoing doctoral research, preliminary findings from a public sector partnering project are discussed. There is a strong reliance on the contract to manage PCCs, which partly removes the power from individuals to negotiate changes. However, PCCs involving specialist information are less constrained by the contract. There is evidence of the Client adapting the contract to their preference and the Contractor opportunistically using the Client's dependency to overprice PCCs, despite claiming to have amiable relations. These seemingly contradictory behaviours emphasise the complexity of interactions around different PCCs, involving different individuals.

Keywords: ethnography, partnering, post-contract changes, power, procurement.

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IMPACT OF THE PUBLIC PROCUREMENT REFORM ON PUBLIC BUILDING PROJECTS DELIVERY IN NIGERIA

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Reducing the cost of public projects' delivery is a major challenge of Governments worldwide and increasingly procurement reforms are considered as unique means of achieving lower costs for infrastructure delivery and value for money. Thus the Nigerian Public Procurement Reform is expected to result in significant improvement in public projects' performance which should impact the country's overall economic situation and foster the realisation of the Government developmental target of being among the top twenty economies of the world by the year 2020. This paper analyses the impact of the Public Procurement Reform on public building projects' delivery in Nigeria. The impact of the Public Procurement Reform is hypothesized to depend on crucial factors such as planning practices for public building projects, adoption of appropriate procurement options, contractor selection practices and the enthroneing of best ethical standards by public building practitioners. Actual project performance data were compared on public building projects delivered prior and after the commencement the procurement reform. In addition, a sample survey comparing opinions of key practitioners on the impact of the reform on public building projects' delivery was carried out, and the result of the pilot study shows there is no significant difference between the mean response of contractors, consultants and construction professionals in Ministries, Departments and Agencies with regard to the reform's impact on irregularities associated with public building projects delivery in Nigeria. Inadequate project/budgeting plans by the client and the project team identified as the most constraining factors in the attainment of desired impact on public building projects delivery. The outcome of this study would provide empirical ground that assists in decisions on the sustainability of the procurement reform in Nigeria, whose experience might be applicable the rest of the developing world and may provide relevant clues to assist other countries.

Keywords: impact, building performance, procurement reform.

THE INFLUENCE OF PROCUREMENT METHODS ON DISPUTE RESOLUTION MECHANISM CHOICE IN CONSTRUCTION

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The success of major infrastructure projects is crucial to economic development. Clients' expectations that infrastructure projects will meet their objectives are however confronted by hackneyed construction and engineering challenges relating to cost overruns, delays, issues of quality and disputes. In dealing with major construction disputes, the focus has been on the promotion of the use of alternative resolution mechanisms. The discussions in the literature on the subject have, however, failed to align the procurement method with the parties' selection of dispute resolution mechanism in the event of disputes. The result of the failure has been cost in terms of resources and relationships. An understanding of the link between procurement methods and DRM will avoid situations where cooperating construction entities end up as adversaries mainly as a result of how disputes between them are resolved. This study reports on the preliminary phase of on-going research into the avoidance/ resolution of major infrastructure project disputes. Initial findings, based on a critical review of the literature and an analysis of DRM provisions in standard forms of contract, show that: (i) The standard contracts have virtually the same provisions on dispute resolution regardless of the procurement method: arbitration, adjudication/dispute board ; (ii) whilst there is ample evidence of the impact of choice of procurement method on project success generally, the literature on the relationship between procurement methods and dispute reduction and resolution is fragmented and of limited direct relevance. What research exists on the subject is primarily confined to an examination of the relationship between procurement methods and dispute frequencies. There are, however, indications from the literature of strong connection between choice of procurement methods and DRM. The implications of the initial findings for the design of the rest of the on-going study are examined.

Keywords: construction, dispute resolution mechanisms, procurement methods, project success, collaborative procurement.

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PROJECT MANAGEMENT

ATTAINING ZERO DEFECTS WITHIN BUILDING SCHOOLS FOR THE FUTURE: A REALISTIC TARGET OR A SISYPHEAN TASK?

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Until its demise in July 2010 The Building Schools for the Future (BSF) programme represented the biggest single UK government investment in school buildings for more than 50 years. One of the key goals of the investment programme was the desire to ensure that pupils learn in High Quality 21st-century facilities that are designed or redesigned to allow for educational transformation in historically underperforming schools who's pupils were often enshrouded in deprivation and social exclusion. This represents a major challenge to those involved in the delivery of the new or refurbished schools. The paper explores the extent to which schools completed under the umbrella of BSF lived up to the government's ideology of 'value for money' a key parameter of which is the delivery of high quality buildings. Drawing on an embedded case study methodology based around one local authority which completed nine secondary schools under the BSF funding model between 2006 and 2010. The findings portray the many challenges faced by constructors in the pursuit of zero defect construction. Critical to this, the authors argue, is the approach used by stakeholders to define and measure the presence of a 'defect'. Analysis of quantitative defect data reported in the paper suggests a large number of those defects identified related to mere cosmetic imperfections caused by inter alia the client team moving the school into the new building rather than serious defects caused by poor workmanship on behalf of the constructor. Findings from the research raise important questions about the use of 'defects' as a performance measurement for quality within the construction sector.

Keywords: building defects, quality, total quality management.

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CURRENT PRACTICE OF VARIATION ORDER MANAGEMENT IN THE SAUDI CONSTRUCTION INDUSTRY

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The complexity of construction projects means that it is unusual to deliver a project without any change during its project lifecycle. Liability to change is an attribute that generally characterises almost all projects. It is assumed that the use of a change management system in construction projects would assist the management of variation orders effectively. Variation order management is not fully understood nor well applied in the Saudi construction industry. In order to better understand the current practice of variation order management at the design stage of public sector construction projects in Saudi Arabia, this paper reports the results of an exploratory study that used a series of interviews with public sector clients and consultants in 2011. Findings indicate that there are currently no formalised approaches to the management of variation orders at the design stage. In addition, there is a general lack of knowledge about managing variation orders. The paper concludes that there is not only a need to apply an appropriate variation order management system to Saudi public sector construction projects at the design stage, but it also presents participants' suggestions of the most appropriate ways of doing so.

Keywords: design stage, public sector, Saudi Arabia, variation orders.

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RE- CONCEPTUALISING AGILE FOR LEAN CONSTRUCTION: THE CASE FOR "AGILEAN" PROJECT MANAGEMENT

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To address limitations of Lean in construction, new paradigms linked to Agile management methods are receiving increased attention. Agile approaches to management in manufacturing and information technology [IT] developed independently and with different objectives. However in applying Agile to construction, theorists have not made a distinction between the two paradigms. Hence the aim of this research is to analyse the appropriateness of Agile manufacturing and Agile IT to construction. A review of the extant literature on both is undertaken and from this it is concluded that Agile IT is more suitable to construction project management [PM] than Agile manufacturing. Then interviews were undertaken with Agile experts and project managers to assess how Agile IT could be applied. The results of the interviews suggest that concepts from Agile IT need to be integrated with those of Lean to be effective in the construction environment, i.e. Agile needs to be re-conceptualised for Lean construction. This paper presents a potentially unifying framework, called "AgiLean PM", which illustrates how waste elimination, through Lean, and the ability to react to change, through Agile, is achieved at the operational level; with PM methods providing the necessary strategic oversight.

Keywords: agile, agilean, leagile, lean, project management.

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HOUSE BUILDING SERVICE QUALITY AND BUYER EXPECTATIONS

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Increasingly, house builders are being challenged to provide services which align with the thoughts and views of potential home buyers in terms of construction and customer service as well as overall satisfaction; which can only be obtained when post-purchase perceptions meet or exceed pre-purchase expectations. The expectation of receiving “good” service from house builders relies on overly used marketing terms such as “customer care” and “customer focus”: both of these terms are aimed at increasing sales and competition within the marketplace, and yet tied to customer satisfaction. It is, however, unclear whether or not house buyers and builders agree on the types and quality of homes which should be constructed with current research suggesting that failings may result from seemingly under-performance in the service delivery process. The findings from questionnaires undertaken describe the agreement between the types of homes being constructed by house builders and the types of homes expected by home buyers in relation to the Code for Sustainable Homes.

Keywords: construction, service quality, house builders, home buyers.

AN INVESTIGATION OF THE FACTORS INFLUENCING THE SUCCESS OF CONSTRUCTION PLANNING FOR THE 2012 OLYMPIC STADIUM: AN ETHNOGRAPHIC STUDY

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Adherence to the planned duration is one of the main criteria when judging whether a construction project is a failure or not. In addition, construction planning is said to be successful if the project completes within the planned duration; or if it identifies an issue well in advance, thereby alerting the project management team to solve the issue before it causes any impact on the completion date. This research investigates the factors that influenced the success of construction planning of 2012 London Olympic Stadium. An approach of participant observation was adopted which is informed by the principles of ethnography: one that reports the participants' view of their world rather than imposing an artificial theoretical framework upon it. As a senior planning engineer working professionally on the Olympic Stadium from pre-construction until final completion, key human-relations factors were observed and identified that had an impact on the management and execution of the construction planning. The success factors were identified and relate to, for example: the effectiveness of preconstruction planning; the inclination of top organisation hierarchy towards construction planning; the inter relationship between the project participants; the influence of the client and contract; and the efficiency of planning team. It was found that a 'shadow culture' exists between the project participants which, it is argued, is only observable from the perspective of an embedded participant observer. This shadow culture acts to enable the management of the planning process and its efficacy relates to the 'quality' of human inter-relationships in the planning team and amongst immediate stakeholders. The research concludes by questioning the myth amongst project participants that construction planning is a mechanistic process that has to be conducted solely by the planning team.

Keywords: construction planning, inter relationship, participant observant, shadow process.

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A GENETIC ALGORITHM FOR RESOURCE LEVELING OF CONSTRUCTION PROJECTS

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Critical path method (CPM) is commonly used in scheduling of construction projects. However, CPM only considers the precedence relations between the activities and does not consider resource optimization during scheduling of projects. Optimal allocation of resources can be achieved by resource levelling. Resource levelling is crucial for effective use of construction resources particularly to minimize the project costs. However, commercial scheduling software has very limited capabilities for solving the resource levelling problem. In this study a genetic algorithm (GA) is developed for the resource levelling problem. The performance of GA is compared with the performance of Microsoft Project 2010 for several sample projects. The comparisons indicate that the GA outperforms resource levelling heuristic of Microsoft Project 2010 significantly. Furthermore, exact solutions were obtained for the sample problems using linear-integer programming technique. Exact solutions reveal that the algorithm is capable of achieving adequate solutions. Hence, the GA provides a powerful alternative for the resource levelling problem.

Keywords: project management, resource levelling, genetic algorithms, optimization

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ADAPTION OF STRUCTURED ANALYSIS DESIGN TECHNIQUES METHODOLOGY FOR CONSTRUCTION PROJECT PLANNING

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The construction industry has been heavily criticised by researchers and governmental organisations for its performance especially excessive delay. Ballard and Howell (2003) indicated that only about 50% of the tasks on weekly work plans are completed by the end of the plan week. This is a result of a lack of either effective project planning or effective production control. It therefore seems the traditional approach of planning is insufficient to meet the current demand and complexity of construction projects. This paper proposes to critically evaluate the adaptation of Structured Analysis Design Techniques (SADT) methodology as a tool for project planning. SADT which was further developed into IDEF (Integrated Definition) techniques claims to be a complete methodology to provide the means of understanding complex production systems and aid the implementation of change. The use of this methodology has led to process improvement. The research uses a literature review followed by interviews with academics and practitioners to investigate their knowledge and understanding of SADT (IDEF0). The results of the interviews indicated that SADT (IDEF0) methodology is seldom known and used in the construction industry. However, this study indicates that SADT methodology appears to be an effective project planning tool. This study contributes to the limited project planning techniques in construction industry by exploring the possible adaption of SADT.

Keywords: planning, project control, project management.

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THE ROLE OF PROBLEM SOLVING IN CONSTRUCTION MANAGEMENT PRACTICES

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Quality issues are a topic of continuous interest in the Danish construction industry. Not only can failures and defects be vital to the success of the single project but also the annual profits of the whole company can be put at risk. Moreover quality issues jeopardize the reputation of the entire industry. An Industrial PhD carried out at a large Danish contractor examined how failures and defects are produced and handled in the social practices of construction projects. The study addresses quality issues related to project management and examines the role of problem solving practices in the creation and redressing of failures and defects in construction processes. The theoretical framework is based on theory of structuration and enables the central analysis that includes underlying structures of the actors as well as the processes of structuration. The research project is designed as an abductive research process where theory and empirical data inform each other in iterations. A 15-month ethnographic field study comprised of workplace observations and qualitative interviews was carried out to be able to study the internal structures of the agents and the effect of their general-dispositions regarding quality issues in the decision making and redressing of defects and failures in the processes. The role of problem solving and trouble-shooting is analysed through the well-organized processes of erecting the pre-cast concrete structure and the chaotic processes of constructing the penthouse storey on top of the building. The research highlights reactive and proactive problem solving practices as important for the completion of the construction project. Problem solving practices are however often forced into a reactive problem solving. Implications to the company are to direct the attention not only to the planning but also to facilitate and support the problem-solving and trouble-shooting competencies of projects managers.

Keywords: building defects, problem solving, project management, quality, structuration.

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PROJECT PERFORMANCE

IMPROVING PROJECT PERFORMANCE OF PPP/PFI PROJECT-BASED ORGANISATIONS

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The concept of PPP/PFI promises a radical change to improve project performance and better service delivery to the public but evidence on cost and quality gains seems to be limited considering the financial commitments entered by governments around the world. This has encouraged significant number of researches based on diverse PFI projects in the United Kingdom to understand how PPP/PFI projects have performed based on cost, time, quality and operations. Nevertheless, these reports present inconsistent project performance outcomes as different data and methodologies are presented which can lead to more confusion to understand how well PFI projects have performed. Overall, the criticisms levelled against the construction industry concerning the performance of PFI projects executed have not been encouraging. Although, previous studies have identified and investigated factors that can assist to improve project performance recent studies still suggest that how to improve project performance is a perennial problem to construction professionals and project management researchers. In addressing this problem, this paper aims to re-examine these factors to consider which positively influences project performance. Also, the paper proposes the network perspective as a means to attract and transform new knowledge to improve construction delivery processes. By implementing the network perspective, practitioners and managers can explore new areas to create value to improve their project performance. This paper empirically identifies significant factors in the context of PFI projects to improve project performance, drawing upon case studies and questionnaire survey of PFI practitioners involved in on-going PFI projects in the United Kingdom. The main findings show that: 1) collaborative networks; 2) sustainable construction products; 3) clarity in project design for buildability; 4) life-cycle costing; and 5) benchmarking and market testing are significant factors to improve PFI project performance in the construction industry. Overall, the findings of this paper show that PFI projects are no different from non-PFI projects as these issues are critically applicable to all projects. Hence, the practical implication is that practitioners and managers can use the findings to plan and enhance the performance of their projects. Also, it provides guidance on how the network approach can be a potential means to improve the performance of construction projects.

Keywords: collaborative network, project performance, PPP/PFI, project-based organisations, United Kingdom

GLITCHES, SNAGS AND CRISES: A STUDY OF CHANGE IN HOSPITAL ADAPTATION PROJECTS

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Design and programme changes during refurbishment projects remain a considerable cause of concern for UK National Health Service (NHS) Estates managers, due to their potential to disrupt or delay projects and increase cost uncertainty. Similar concerns also impact on the engineering sector, especially in the production of complex, highly engineered products. The techniques developed to study and manage engineering change may have positive benefits for construction. This research looks at the mechanisms of change that operate in refurbishment projects with the aim of identifying commonalities with engineering change. Hence, the research adopts an engineering approach to change and evaluates three very different NHS refurbishment projects, to explore change events and identify options for limiting the consequences of change. The projects chosen for this study were markedly different, with specific drivers, procurement methods, contracts and building systems. One project concerned the construction of a factory-fabricated, modular extension to a UK hospital, whilst a second entailed a "state of the art" refurbishment of an existing neo-natal unit. A third project involved a heavily constrained ward refurbishment. Factors which influenced the level and complexity of change frequently resulted from the lack of accurate information at crucial stages, particularly related to the existing building structure and condition. However, the necessary changes followed very different trajectories. This study forms part of a much larger investigation which aims to develop sustainable adaptations for hospital buildings in response to the changing climate.

Keywords: change propagation, refurbishment, hospitals, constraints, engineering.

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EVALUATION OF KEY METRICS FOR MEASUREMENT OF PROJECT PERFORMANCE

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In the construction industry particularly in developing countries, minimal attention has been given to the application of Performance Measurement Systems [PMS], despite being one of the most important factors for assessment of project success. Consequently, there appears to be always a gap between actual results obtained in relation to delivery of major projects and stakeholder expectations. The application of performance measurement systems in the construction sector has tended to rely on three basic criteria: time, cost and quality, which can be applied to determine the extent of project success. At organisational level, performance measurement systems are largely based on financial measures which are almost always lagging indicators. In response to the Egan Report, the UK construction industry developed specific Key Performance Indicators (KPIs) which include construction cost and time, cost predictability and time predictability, defects, client product and service satisfaction, safety, profitability and productivity. The primary aim of this paper is to evaluate the main project and organisational performance metrics including financial and non-financial measures that have been developed in recent years. Lagging indicators focus on past data and offer little or no opportunity for process improvement. Previous research indicates that credible performance metrics should consider all construction project stages alongside stakeholder needs and expectations. In this work, the fundamental requirements for suitable performance metrics are identified. Finally, it is concluded that the shortcomings of current performance measures utilised by the construction industry can be considered as marketing tools as opposed to tools for process improvement.

Keywords: performance measures, performance metrics, performance measurement systems, construction projects, project performance.

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EVALUATING POLITICAL ASPECTS OF SUCCESS FOR PPP/PFI SPORTS HALL IN CROATIA

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Private Finance Initiative (PFI) is used to deliver public services that are not commercial in nature (e.g. public schools or public health care). Naturally Public sector Clients want to achieve successful PFI projects and they need to have a tool for evaluating achieved success. Due to the fact that PFI projects are often capital projects, they have essential development purpose and attract a lot of political attention. Possibility of measuring political aspects of PFI project success for Public sector Clients is explored. Important success criteria called "Achievement of political goals (APG)" and "Political support (PS)" for evaluating political aspects of PFI project success are identified with application of analysis and synthesis methods. Every success criterion in context of PFI project contains inherent characteristics and different measuring method used for each criterion. To enable comparison of achieved success results by different success criterion, model for application of considered success criteria on evaluating political aspects of PFI project success for Public sector Clients is suggested. Empirical applicability of proposed model for evaluating success with considered criteria is demonstrated at Sport hall in Town Varaždin, as one of the pilot PFI project in Croatia. The political determinants of success for PFI project "Sport hall in Town Varaždin" have achieved considerable success level.

Keywords: PPP, PFI, project success, Croatia

DELIVERY OF COMPLEX CONSTRUCTION MULTI-PROJECTS IN CONTRACTOR-LED PROCUREMENT

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As the demand for Contractor-led procurement routes for large and complex projects increases, the pressure for improved delivery also increases, putting the construction contractor at the fore-front of creating value through innovation, collaboration and integrated working. Companies have to adopt approaches that not only successfully deliver a single project at a time but which recognise the multi-project environment of the construction contractor. This research builds upon a theoretical socio-technical systems framework for understanding and managing complex construction projects. The paper outlines the evaluation and revision of the framework through a series of expert interviews and pilot case study. Empirical feedback is used to provide a better understanding of the nature of complex construction projects and an insight into how they can be managed accordingly.

Keywords: socio-technical systems, contractor, framework, collaboration

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RESEARCH METHODS AND NEW PERSPECTIVES

A NEW RESEARCH AGENDA INTO COMMUNITY-BASED PROTEST IN CONSTRUCTION

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Many countries face enormous development challenges in adapting to demographic change, urbanisation and emerging issues such as housing affordability and climate change. These challenges are best resolved in consultation with communities rather than in conflict with them. A rich tradition of research and intellectual frameworks exist in the fields of urban geography and planning to understand and manage community concerns during the pre-development approval stages of new projects. However current theoretical frameworks are inadequate in construction management and a new research agenda is needed to develop conceptual frameworks to guide thinking about the role of communities in the construction process. By discussing the components of such a model, it is concluded that this would require a fundamental shift in thinking which challenges traditional structuralist paradigms. A new constructivist paradigm is presented that conceives community consultation as a negotiation process which does not stop at the pre-development planning stages but which continues over the entire life of a project.

Keywords: community, protest, social constructivism, development, housing, infrastructure

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PARADIGM INTERPLAY TO DEVELOP A SUSTAINABILITY RELATED KNOWLEDGE MANAGEMENT STRATEGY

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In the construction industry two approaches to Knowledge Management (KM) can be distinguished. First, a functionalist perspective encourages the development of KM strategies and systems aiming to capture, reuse and manage technical knowledge usually with the help of databases and computerised systems. Second, an interpretivist perspective where knowledge is viewed as not existing independently from human interactions with a focus on the development of social structures and processes within organisations. This paper presents the methodological approach to develop a Sustainability-Related KM Strategy (SKMS) for Housing Association (HA) planned works (cyclical replacement of housing components). In this research the authors acknowledge the managerial benefits for construction practice of the functionalist approach but also argue that the socially constructed nature of knowledge requires the interpretivist approach to be considered within the development of the research methodology. As a result, the authors advocate the use of an interpretivist research paradigm with a functionalist perspective to knowledge and explore this through the context of this research, with the benefits and challenges to paradigm interplay considered.

Keywords: research methodology, knowledge management, interpretivism, functionalism, paradigm interplay.

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MODELLING THE IMPACT OF EXTREME WEATHER EVENTS ON HOSPITAL FACILITIES MANAGEMENT USING A SYSTEM DYNAMICS APPROACH

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Heatwaves kill more Australians per year than any other type of natural disaster and are predicted to increase in intensity and frequency due to climate change. Effectively designed and managed hospitals are therefore a critical and central part of a community's response to such events. While our understanding of these impacts is increasing, the impacts of potential knock-on effects from other critical infrastructure are not well understood. Using a case study approach, system dynamics is used to investigate the impact of heatwaves on community infrastructure and healthcare facility management outcomes. This provides hospital facility managers with a new way to understand and maximise the resilience of hospitals to the effects of extreme weather events.

Keywords: facility management, heatwaves, system dynamics, hospitals, risk management, health, extreme weather events

RESOLVING THE METHODOLOGICAL CONUNDRUM: BOLSTERING THE RESEARCH ACHILLES HEEL IN SOUTH AFRICA

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Determining, understanding, writing and applying research methodology to treatises, dissertations and theses has been and continues to be a major challenge for students and supervisors alike. This research was thus conducted in order to chart a pathway out of the methodological conundrum. The method used is an expository review of the methodology chapters of existing honours treatises, masters treatises and dissertations, and doctoral theses archived in a South African university. The critical literature examination was however limited to construction management research (CMR) outputs. The findings reveal that the research planning, locating the related literature, balancing between describing the problem qualitatively and quantitatively, establishing the number of parameters that need to be measured / observed, and determining the nature of the research problem are the weak points in the establishment of an appropriate philosophical position and associated selection of method. Moreover, there are instances where instead of letting the nature of a particular research problem dictate its means of solution, favourite methodological frameworks and methods were employed without a reflection about the features of the problem. The implication for this research is that it is necessary to situate the research background in the relevant research paradigm. In other words, resolving the methodological conundrum could bolster the research Achilles heel that has hitherto bogged down research productivity and completion.

Keywords: education, philosophical position, research methodology, South Africa

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CONTEXTUALISING INNOVATION IN CONSTRUCTION FIRMS IN REGIONAL AREAS

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Construction firms based in regional contexts face different challenges to their metropolitan counterparts in terms of access to markets and resources, scale of operations, and the nature of their competition. This potentially provides both business opportunities and challenges particularly in relation to innovation activities. A large scale research project investigating innovation processes in an Australian regional construction industry is being contemplated and a research mechanism has been piloted. Accordingly the case of a successful regional New South Wales small-medium-sized enterprise's (SME) quest for sustainable competitive advantage is presented through the lens of a dynamic capabilities framework. It reveals four capabilities that deliver innovation, one of which is regional in flavour, indicating that a regional location need be no impediment to innovation and indeed may hold some advantages

Keywords: construction firm, dynamic capabilities, innovation, SME.

RISK MANAGEMENT

INCORPORATING SECURITY MEASURES INTO THE BUILT ENVIRONMENT

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The protection of the built environment has been given increasing attention over recent years, with physical interventions being integrated into the built environment itself and an impetus on the role of those who are responsible for its design, construction and operation. Of particular note has been debate and behaviour surrounding the incorporation of security measures to specifically mitigate terrorist threats, as varying perceptions regarding obligations and incentives to do so have resulted in vulnerable places remaining unprotected. As part of on-going research into the security of the built environment, a three-year study into the protection of crowded places from terrorism has determined the factors that influence whether such measures are incorporated into built assets, in order to further understanding of the perceptions and reality behind decision making. Drawing on data obtained from interviews with 47 construction management and security professionals in the UK and USA, as well as observations during site visits and document analysis, a framework is put forward that presents the factors that influence whether security measures are incorporated, as well as the factors that influence the value of the measures themselves. The framework highlights the need to consider the incorporation of physical measures during the early design stages whilst also reconciling the requirements of such measures against those of other design criteria; to understand the intricacies surrounding risk mitigation within time and cost constraints, and to accrue maximum value. Such a framework, it is argued, would aid policy and key decision makers in co-ordinating their efforts and effectively protecting vulnerable places from the range of risks that the UK faces, thereby mitigating a range of natural hazards and major accidents, not just specific threats.

Keywords: counter-terrorism, design, risk, safety, security

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PERCEPTIONS OF FUZZY SET THEORY IN CONSTRUCTION RISK ANALYSIS

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Over the last three decades, organizations have increasingly been taking account of risk and uncertainty in their decision-making processes. The traditional methodology for risk management involves risk identification, risk analysis and management response to risk. Common risk analysis techniques in the construction industry include sensitivity analysis, probability analysis, Monte Carlo simulation, beta analysis etc. In this regard, Monte-Carlo simulation has been a touchstone of simulation efficiency across contemporary literature on risk analysis. However, a number of concerns have been raised about the intractability and construct validity of Monte Carlo representations for construction risks. The use of Monte Carlo simulation is based on the premise that the uncertain or risk event can be defined by a known probability distribution function. Unfortunately, this is not the case as far as risk is concerned in construction projects. It is in situations such as these where precise probability density functions cannot be ascribed to uncertain events that fuzzy set analysis becomes helpful. This research investigates the perceptions of fuzzy set theory and its influence on the practice of construction risk analysis. This work is part of a larger study that aims to investigate the specific insights that fuzzy set theory could bring into the construction risk analysis discipline. Purposive sampling was employed in selection of participants for the investigation. Structured interviews were conducted with highly experienced construction professionals in the United Kingdom. The results of these studies reveal that fuzzy set theory can enhance reasoning in analysing construction risks. However, fuzzy set theory as a stand-alone mathematical tool is not sufficient to complete the risk analysis process. Furthermore, the study indicates the vulnerability, volatility and computational intensiveness of fuzzy set theory may discourage construction practitioners from embracing the principles and applications of fuzzy set theory

Keywords: decision analysis, fuzzy set theory, risk analysis, risk modelling.

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AN EXAMINATION OF THE RISK MANAGEMENT PROCESS IN VENEZUELAN CONSTRUCTION PROJECTS

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The construction industry has many sources of risk some of which can be attributed to the complexity of processes, the environment of construction projects, financial aspects, organizational structures and technology usage. In the success of construction projects, the importance of identifying and managing risks is widely acknowledged. Delays in time and cost overrun have become the most common risks facing the industry worldwide. However, they are particularly prevalent in developing countries where adversities such as shortage of materials, lack of management skills, unskilled labour as well as socio economic and political problems must be dealt with; all of which make construction projects more difficult to manage. Interviews with project managers responsible for projects in the public and private sectors were carried out in order to evaluate their perception of risks, how they manage these risks and the effects of the risks on their projects. The results of the investigation show the main sources of risk identified relate to: the risk management process; organizational structure; labour unions; and economic factors. For example, the Venezuelan construction companies face risks as a result of the current economic situation brought about by the currency exchange controls applied 10 years ago. This is causing a negative impact on the procurement and costs of construction projects. This paper explains how these factors are managed and their impact on time and cost. One of the recommendations proposed as a way of improving the risk management process in Venezuelan construction projects is to assess the internal processes and organizational structure of project management companies. This will aid advanced identification of the sources of risk in order to allow timely decision making.

Keywords: organizational structure, risk management, sources of risk, time delays.

REVIEWING RISK ALLOCATION FOR INFRASTRUCTURE PFI: BETWEEN THEORY AND PRACTICE

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Risk allocation (RA) in PFI infrastructures resides in a complex milieu. Tackling this issue from both theoretical and practical perspectives is important in order to understand its complexities. It is claimed that PFI deals can result in better value for money through proper RA. However, the common notion of the public sector transferring ALL risks to the private sector does not describe the reality nor define the optimum way of dealing with risks in infrastructure PFIs. In order to analyse the process of RA, an extensive literature review is undertaken to compare the theory and the practice of the process. It is concluded that a considerable gap exists and the main reason for that is the absence of consensus around the logic/theory of the PFI itself.

Keywords: infrastructure, PFI, risk allocation, risk identification, uncertainty.

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SUSTAINABILITY – (OPERATION AND PRACTICE)

EVALUATING FACTORS IN SUSTAINABLE ROAD CONSTRUCTION AND MANAGEMENT – A LIFE CYCLE APPROACH

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Roads perform an important connecting function for the community. At the same time their design, construction and operation are not always easy from the point of view of sustainability. Achieving sustainability in this process requires the undertaking of initiatives such as sound environmental management, water sensitive urban design, use of advanced and recycled materials, and environmentally responsible project management and construction. The contribution of such factors to a particular road project can be different for alternative options for constructing and managing the road. This can be an issue in comparing these options. A methodology is proposed to address this issue through calculating a weighted score of the sustainability related economic, environmental and social factors for each option, using a life cycle management approach that considers stakeholder requirements. As the variables in this process tend to be measured in a range of units and may be either quantitative or qualitative, each variable in a given road construction option is both given a weight and also assigned a suitable comparative score obtained through calculation for quantitative variables, or using a utility approach for qualitative variables. The calculated total weighted scores for various road construction and management options may then be compared when assessing the most sustainable option. An example calculation that compares the weighted sustainability for two road construction options is provided. The approach described is flexible and may be used in conjunction with other methodologies, and is also capable of being developed into a suitable computer based modelling tool.

Keywords: sustainability, roads, development, construction, management.

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INVESTIGATING A SUITABLE LEARNING ENVIRONMENT TO ADVANCE SUSTAINABLE PRACTICES AMONG MICRO CONSTRUCTION ENTERPRISES

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Sustainability in the construction industry is increasingly at the forefront of current debate and government policy. The majority of sustainable strategies and research has focused on large contracting organisations with little attention given to Micro Construction Enterprises (McE's). With McE's comprising of 98% of all UK construction firms they clearly contribute significantly to the delivery of sustainability. There is little understanding of the unique challenges McE's face in learning and knowledge acquisition to advance sustainable practices. McE's are a diverse group of professional practices, specialist trades and general builders and it is doubtful they are well equipped to support the learning culture necessary to appreciate the current myriad of sustainability issues. This research explores the requirements for a suitable learning environment for McE's to advance sustainable practices. Through semi-structured interviews with eight owner/associates of different types of McE's in Glasgow, the research explored their preferences for learning in order to establish the basis for a suitable learning environment. Formal methods of learning like seminars and CPD events entail prohibitive cost and resource barriers, but analysis suggested that these constraints could be appeased by facilitating voluntary informal learning pathways in order to progress the agenda. Since the majority of the study participants were members of some trade or professional association it is recommended that these bodies are best placed to deliver contextually relevant resources in a suitable narrative for McE's. The paper attempts to differentiate between formal and informal learning styles to promote sustainable practices among McE's.

Keywords: knowledge, learning, micro construction enterprise, practice, sustainable construction

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GREEN BUILDING CHALLENGES: EVALUATING THE OPERATION OF ADOPTED BUILDING ASSESSMENT TOOLS - CASE STUDY

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In recent years, the green building environmental assessment tools (BEATs) are increasingly being adopted from one country to the other. Previous authors have proposed several ways for improving the performance of BEATs precisely, the second generation tools adopted from elsewhere. However, a few studies have focussed on how the tools are operated in their new contexts. Therefore for further advancement of this emerging field in the property and building sector, the current work compares the operation criteria of the original and adoptive tools in order to analyse the implications associated with the adoptive tools hence suggest ways for improvement. Focusing on the Green Star tool as a case study, a few implications have been highlighted relative to facilitation, accreditation and implementation criteria of the tools. Although there is no clear-cut for promoting BEATs based on how are structured, continuous improvement of the BEATs in specific contexts is needed.

Keywords: adoptive countries, building assessment tools, green building, green star tool, operating criteria.

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INVESTMENT APPRAISAL TOOLS AND SUSTAINABILITY EVALUATION IN SOCIAL HOUSING

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Conventional decision making in all aspects of the asset management sector has largely been based around the key concepts of risk reduction and maximisation of returns. Yet the RICS (2009) has called for surveying professionals to significantly modify their current practice to ensure it aligns with the government policy which has sought to encourage sustainable development through sustainable construction and property management. For organisations operating in the social housing sector this has meant reinvesting, through regeneration and improvement programmes in their existing socially excluded neighbourhoods in order to deliver 'sustainable communities.' The work reported in this paper focuses on a quantitative study executed to assess the extent to which current practice in the social housing sector has been modified to consider sustainable aspects of property investment, and specifically to identify the tools and techniques used. Using a questionnaire survey data was gathered from 250 social housing providers in the United Kingdom achieving a response rate of 15%. The interim findings suggest whilst social housing property directors understand the importance of considering sustainability they have not yet achieved the paradigm shift in terms of its implementation called for in the literature.

Keywords: asset management, investment appraisal, social housing sustainability.

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EARLY STAGE EVALUATION OF THE SOCIO-ECONOMIC BENEFITS OF BUILT ENVIRONMENT HOUSING REGENERATION PROJECTS

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In recent years, sustainable regeneration has been recognised as being of major economic and social concern in the world. In the UK for instance, government has initiated a number of policies and evaluation methods to deal with some of the environmental problems associated with regeneration projects. However, the post construction evaluation of these projects has often resulted in them being seen as not achieving their set objectives. Attempts aimed at evaluating the implementation of sustainability by built environment professionals have primarily been limited to their assessment of the projects' potential environmental impacts with the associated socio-economic aspects being neglected. While there have been a number of studies on sustainability and its evaluation in relation to regeneration projects in the UK, there has not been any well-defined built environment research that has been able to deal holistically with the broader issues of sustainability in terms of benefits/impacts of the regeneration projects to the end-user and the communities concerned. The findings of an exploratory study that adopted a semi-structured interviews approach for data collection from six senior regeneration managers of construction industry organizations involved in housing regeneration projects in the UK are presented in this paper. The findings reveal a lack of a mechanism to evaluate the socio-economic benefits of sustainability in relation to housing regeneration projects at the early stage of the project's development. The results suggest that the environmental factors of sustainability continue to be the most dominant factor of sustainability considered by built environment practitioners as compared to the consideration of a project's potential socio-economic benefits.

Keywords: socio-economic benefit, sustainable housing, regeneration projects.

BUILDING REFURBISHMENT: HOLISTIC EVALUATION OF BARRIERS AND OPPORTUNITIES

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With the significant reduction in the number of construction projects due to the economic meltdown in the last three years, which is feared, may continue well into this second decade, the refurbishment of old and existing buildings may be perceived as a strategic avenue through which property owners could secure value for money. It is common knowledge that aged buildings are constantly growing in number with a concomitant growing pressure to maintain their utilitarian values in the face of changing technology, legislation and sustainability issues. Indeed, the majority of buildings in the UK pre-date the emergence of the modern concepts of sustainable development. Wholesale demolition of these buildings can be quite unhealthy from an environmental protection perspective as it causes heavy pollution as well as placing more demand upon depleting resources. Nevertheless, the demand for sustainable, energy efficient buildings from both regulators and occupiers is increasing despite the recession. However, is the inclination to refurbish rather than demolition and new-build becoming stronger? This paper explores the barriers and opportunities for building refurbishment schemes as an economically motivated activity through which the performance and value of a property can be enhanced. It is based on comprehensive literature review as part of on-going doctoral research programme on risk structure in building refurbishment schemes. It concluded that refurbishment is substantially cheaper than demolition and new-build and that a refurbished building can be as functionally efficient as new-build.

Keywords: existing buildings, refurbishment schemes, sustainable development

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FACTORS OF SUSTAINABILITY IN BUILDING DESIGN: ESTABLISHING THEIR RELATIVE SIGNIFICANCE

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There has been a growing movement towards sustainable building in the past number of decades and in that time a variety of terms have evolved to describe this design ethos such as green buildings, passive buildings, carbon neutral buildings, low carbon buildings, all of which are different but all of which are striving for similar outcomes. For a building to achieve any of these status the design must take into account a number of different factors. The aim of this research is to establish the factors of sustainability relevant to the evaluation of sustainable buildings and to establish the significance placed on individual factors of sustainability in buildings. This was done by firstly identifying in a holistic manner everything which could be considered a factor of a sustainable buildings. These were then presented as a questionnaire to construction professionals with experience in the design and procurement of sustainable buildings who were asked to indicate the significance they have placed on each of the factors. The results of this exercise showed a) that while for many of the factors there was broad agreement as to their relevant significance, for others opinions varied greatly and b) not all factors are of equal importance with some being scored consistently lower than others. This suggests that amongst the group surveyed there is no overall consensus as to the significance to be placed on the factor contributing towards the design and procurement of a sustainable building.

Keywords: design, green buildings, sustainability.

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INTEGRATING RESPONSIBLE SOURCING IN THE CONSTRUCTION SUPPLY CHAIN

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Certification to industry standards is the most tangible means for a company to prove its commitment to sustainability issues. The construction sector is of particular interest, due to the huge impacts of its operations. Many companies operating within the sector have implemented environmental management systems in line with ISO 14001 although recently the industry has become focused on the concept of responsible sourcing (RS); the ethical management of sustainability issues associated with products and materials in the construction supply chain. An adoption of this concept can be evidenced by certification to BES 6001, the framework standard for responsible sourcing. Despite this, the number of accreditations is relatively low and knowledge and awareness of RS is still limited. This review paper explores the reasons behind the under-emphasis of RS within the industry, despite a continually increasing knowledge of the Corporate Social Responsibility (CSR) agenda. Currently, opinion is divided on whether CSR and RS represent a form of corporate philanthropy or a channel by which revenue can be increased. The issue is further complicated by the presence of engineered-to-order (ETO) products, which creates barriers to the enactment of RS and CSR principles. These are explored and possible explanations for their absence from supply chain management issues offered. Furthermore, the potential to extend the interpretation and application of the ISO 14001 framework to demonstrate the consideration of these principles is presented. Other certification schemes of particular significance to the industry and the problems for companies to achieve certification are also discussed; in particular, access to financial and other resources are identified as a key barrier to certification, especially for SMEs. Recommendations are made for future research that might enable SMEs to achieve sustainability certification more readily and to help the industry embrace the concept of RS more broadly.

Keywords: corporate social responsibility, engineer-to-order, responsible sourcing, supply chain, sustainability certification.

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LOWERING CO₂ EMISSIONS IN THE NEW BUILD SOCIAL HOUSING SECTOR: A SPANISH CASE STUDY

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As part of a larger UK/Spanish comparative study, this research focuses on a new build social housing development in Spain, and examines the measures being adopted by those mandated to comply with the provincial planning laws as well as the relevant national building regulations which demand the inclusion of measures to lower CO₂ emission levels. Focusing on the socio-technical networks of the principal stakeholders involved, and utilising a multi-level perspective, the research aims to better understand how provincial planning and building regulation requirements are being met, both through fabric improvements and the use of low and zero carbon technologies. Emerging findings from the case study suggest the stakeholders involved in the delivery of social housing view the introduction of such technologies differently, and this interpretation may depend on their specific view of the technology being deployed and the role they perceive it to play within their working environment. Perceptions of the new technology and fabric upgrades demanded by the new regulations are generally positive, but there is disagreement regarding technological performance and misgivings regarding its introduction given the prevailing economic situation in Spain. Implications for practice may suggest better communication between suppliers and installers, as well as some additional technical support from the technology manufacturer to help bridge perceived performance shortcomings. For policy, given the difficulty encountered during the pilot study in identifying housing developments working to the CO₂ improvements mandated by the 2006 regulations, it may prove fruitful to tie future revisions of this legislation more closely to planning permission consents.

Keywords: carbon, housing, multi-level perspective, socio-technical networks, Spain.

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ENVIRONMENTAL ASSESSMENT TOOLS AND EFFICIENCY IN HOUSING AND OFFICE REFURBISHMENT

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Most environmental sustainability assessment tools are focused on new construction while refurbishment of buildings presents a different picture. Short term, local environmental effects such as noise or dust are more frequent in a refurbishment process since both occupants and neighbours are affected whereas in new construction only neighbours might be affected. The purpose of this paper is to provide a framework in order to assess strength and weaknesses of environmental assessment tools for housing and office refurbishment projects, taking into account practical aspects, fundamentals of sustainability as well as conflicts between sustainability and efficiency. A review of literatures on sustainability, measurement systems in general and major environmental assessment tools confirms that these tools focus on energy consumption, heat insulation, air quality, light, noise, water efficiency and material consumption in new construction, but rarely in a refurbishment context. Short term, negative effects during a renovation process are not covered by current environmental assessment tools. The conflict between local and global effects of sustainable refurbishment, users' needs, workers' efficiency during the refurbishment process, problems caused by occupants and waste management should be reflected in a framework for indicators to be used in refurbishment projects. Since there are important effects on building users involved in most refurbishment processes, more attention should be paid to the relation between their productivity and both economic and social sustainability.

Keywords: environmental impact, measurement, productivity, refurbishment, sustainability.

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VARIATIONS IN THE MAINSTREAMING OF SUSTAINABILITY: A CASE STUDY APPROACH

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The construction sector has a major role to play in delivering the transition to a low carbon economy and in contributing to sustainable development; however, integrating sustainability into everyday business remains a major challenge for the sector. This research explores the experience of three large construction and engineering consultancy firms in mainstreaming sustainability. The aim of the paper is to identify and explain variations in firm level strategies for mainstreaming sustainability. The three cases vary in the way in which sustainability is framed – as a problem of risk, business opportunity or culture – and in its location within the firm. The research postulates that the mainstreaming of sustainability is not the uniform linear process often articulated in theories of strategic change and management, but varies with the dominant organisational culture and history of each firm. The paper concludes with a reflection on the implications of this analysis for management theories and for firm level strategies.

Keywords: corporate sustainability, corporate strategy, neo-institutional theory, organisational culture

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OPTIMISING THE ROLE OF FACILITIES MANAGEMENT (FM) IN THE DEVELOPMENT PROCESS (DP): THE DEVELOPMENT OF FM-DP INTEGRATION FRAMEWORK FOR SUSTAINABLE PROPERTY DEVELOPMENT

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The purpose of this study is to establish the critical success factors needed to optimise the integration of facilities management (FM) into the full development process (DP). This paper offers an initial finding towards development of FM-DP integration framework. An extensive literature review is provided, drawing critical links between FM, project management and property development and highlights the importance of integrating FM in the wider property life cycle. Differences in opinion with respect to the contribution of FM-DP integration to sustainable development are also highlighted. The paper found a broad understanding on the development process and different views on the most effective position of FM within the development process. FM aspects can be incorporated in four strategic areas in the development project namely the early stage (investment program, project initiation and planning and design stage), construction stage, operation stage (after handing over and occupational) and/or can be implemented throughout development process. The proposed FM-DP framework offers a new perspective on the role of facilities management in the full development process, and its wider contribution to sustainable development. This research provides new ideas into the current views on the importance of FM-DP integration. The framework provides social implications for the consideration of FM within the property and construction industry, and considers the critical factors required to fully integrate FM within this process.

Keywords: development process, facilities management, framework, optimisation, sustainable development.

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DETAILED DESIGN ETHNOGRAPHY: ARCHITECTS EMBEDDING LOW CARBON PERFORMANCE

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The United Kingdom is aiming to enforce nearly zero carbon buildings by 2020. The plan has been set into three-year incremental periods to facilitate the transition to zero carbon. In 2008, the Welsh Government announced its aspirations to lead the low carbon pathway in the UK by enforcing higher reduction targets and adopting BREEAM as a planning application condition for new non-domestic buildings. It is anticipated that the building industry will experience changes in its working methods. However, the routine implementation of energy regulations by practitioners remains unknown. In this context, the detailed design phase was investigated to unveil how regulatory requirements were affecting routine architecture practice. The real-time development of a small number of non-domestic projects procured by design and build route was studied by ethnographic methods. The focus was architects' work during detailed design so to reveal how they adopted official tools to embed performance in the fluidity of the process. Architects were using the official assisted to different degrees by informal tools situated in the social context of practice. Architects working on detailed design were likely to transpose, follow and learn about the energy aspirations during low carbon problem solving. Official and informal tools could occupy central, peripheral and mediating roles in the design of low carbon; affecting the articulation of energy aspirations during detailed design and delivery. The in-depth understanding of how low carbon was embedded during detailed design provides insights about how practitioners coped with energy regulations and how low carbon design process could be improved.

Keywords: energy, design, building regulation, design and build, architecture.

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A CRITICAL REVIEW OF THE CONCEPT OF FACILITIES MANAGEMENT IN COMMUNITY-BASED CONTEXTS

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The concept of Facilities Management in a Community-based setting is derived from understanding the social value of community facilities and the management of community assets, which include people, buildings, voluntary groups and organisations. This research forms part of a PhD study, which aims to critically review the concepts of FM and translate knowledge into the community setting, in order to develop new thinking and demonstrate the added value of FM in the regeneration context. For the purpose of this paper, a critical review is undertaken to identify the key characteristics of FM in the community-based setting emerging from literature. Further analysis is then undertaken to demonstrate the potential contribution of FM to community development. The research identified five areas in which FM had the potential to make contributions in a community-based setting, namely: service management, social inclusion, strategic development, environmental and economic sustainability. These covered all the different aspects of the existing concepts and models, bringing together community and organisational issues.

Keywords: community development, facilities management, service delivery, urban FM, social enterprise.

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THE DOMESTICATION AND USE OF LOW AND ZERO CARBON TECHNOLOGIES IN NEW HOMES

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Changes in the Building Regulations are demanding higher levels of environmental performance in the products of house builders in the United Kingdom. New approaches are being deployed, including incorporating low and zero carbon (LZC) technologies, in order to meet this challenge. It is recognised that the use phase of buildings is responsible for a significant majority of the energy consumption and therefore carbon emissions. A corpus of literature exists focusing on the technical potential of individual technologies but there is a relative dearth addressing the role that the end users (or occupants) play in the use of these technologies in the domestic setting of the home. If the overall objective of lowering carbon emissions is to be realised it is therefore critical that a more in-depth and nuanced understanding of the interaction between homes equipped with new LZC technologies and users is developed. Case study data from two households in a new development using solar thermal technology is analysed from a domestication theory perspective. The results show that the households had little knowledge of, or interest in, the technology prior to moving into the houses. The 'market pull' of consumer design or imagination for the solar thermal technology was absent - they were passive consumers. However, once in the houses, the meaning ascribed to the technology and the household practices emerging from user-technology interaction were significantly different in each of the two households. The findings contest the prevailing technical rationality notion that LZC technologies are uniformly absorbed and used by a homogeneous set of households.

Keywords: domestication, housebuilding, low and zero carbon technologies, socio-technical.

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SUSTAINABILITY – (THEORY AND DESIGN)

OPTIMIZING EMBODIED ENERGY OF BUILDING CONSTRUCTION THROUGH BIOCLIMATIC PRINCIPLES

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Climate change and global warming are major issues in sustainable development, with the building sector being responsible for more than one third of global greenhouse gas emissions, and in many countries being the largest source of these emissions. It is believed today buildings are responsible for more than half of the energy consumption worldwide, significantly contributing with the carbon dioxide emissions they are responsible to the very cause of climate change. The knowledge gap that exists with respect to how emissions from built environments can be reduced and mitigated, how buildings and components can adapt to shifts in global and local climate must be filled (Altomonte 2008). A significant proportion of the energy consumed by the building over its life cycle is the embodied energy in building materials and construction processes. The intergovernmental panel on climate change estimated that around 30% of the base line carbon dioxide emissions in buildings projected for 2020 could be mitigated in a cost-effective way globally, at no or even negative costs, if bioclimatic principles were considered in material selection and construction stages of buildings, thus reducing their embodied energy. There are three major ways to reduce energy consumption: reducing building energy use, replacing fossil fuel with renewable energy, and increasing energy efficiency. Therefore, reducing embodied energy in buildings has come into focus as one of the issues in reduction of carbon dioxide emissions and global warming. Reducing embodied energy of buildings by using bioclimatic principles to achieve optimum embodied energy use can improve energy efficiency, and importantly reduce costs and lifecycle energy use. The paper discusses the use of bioclimatic design techniques to identify criteria that can be used to decrease the embodied energy used in building materials and construction processes. The criteria can assist with developing a model and checklist to apply for an optimum embodied energy of actual building which includes both pre-construction and construction stages.

Keywords: optimum, embodied energy, energy reduction, construction management, sustainability, environmental construction process.

THERMAL PERFORMANCE OF BUILDINGS AND THE MANAGEMENT PROCESS

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From the limited information that exists on the thermal performance of dwellings there is growing evidence of a significant gap between that which is predicted and the built product. Such differences between the intended and actual measured performance are not accepted nor tolerated in other industries. The differences in the performance can be considerable, with some buildings experiencing deviation from designed thermal transmittance resulting in twice the heat loss expected. This does not bode well for the industry when new dwellings are expected to achieve zero carbon standards by 2016. Although some of the problems are related to inadequate design, many are attributable to construction processes. Using the technical reports and feedback from researchers engaged in forensic investigations of building performance, this paper presents some general observations and some re-occurring problems associated with the management of the construction process. Specific areas of concern include the interface between design and construction, sequencing and planning of works, quality of workmanship and build, and lack of quality control systems. Due to current environmental and energy concerns, emphasis has been placed on improving the efficiency of the building system to ensure the gains expected are delivered. Much of this relies on the production of quality building fabrics that provide passive solutions, which maintain thermal comfort and reduce the level of service intervention.

Keywords: building quality, coheating tests, thermal performance, workmanship and zero carbon standards

KEY CRITERIA OF SUSTAINABLE HOSPITAL REFURBISHMENT: A STAKEHOLDER REVIEW

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Hospital refurbishment has taken a secondary role in the last decade, in favour of new build facilities. This has allowed the Client and the Design Team to build and specify with greater flexibility and from essentially a 'blank canvas'. Correspondingly, sustainability as an issue has been easier to plan and implement from the earliest briefing and design stage. The changing economic landscape has necessitated that the focus has now shifted to the refurbishment of the existing healthcare estate. Refurbishment is widely recognised as presenting unique challenges in its own right. Add to this the institutional and statutory requirements in the arena of sustainability and the unique functional characteristics of an operational hospital and these challenges are increased. Given the practical and economic challenges of refurbishment as an activity, weighed against a facility as multi-faceted and complicated as a hospital, a structured and prioritised process of decision making is required. A multi-criteria decision making (MCDM) approach is discussed as being most suitable for this process. A pilot study of a non-random sample of industry experts is analysed to establish a baseline knowledge platform of the key research variables and subsequent method of selecting criteria. The overall findings establish a good awareness of sustainable development and familiarity with key documentation and guidance, however knowledge of the capital investment appraisal process and the use of MCDM tools is shown to be very limited.

Keywords: hospitals, MCDM, refurbishment, stakeholders, sustainability.

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A MULTIDISCIPLINARY LITERATURE REVIEW OF LOW AND ZERO CARBON TECHNOLOGIES INTO NEW HOUSING

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The UK Government is committed to all new homes being zero-carbon from 2016. The use of low and zero carbon (LZC) technologies is recognised by housing developers as being a key part of the solution to deliver against this zero-carbon target. The paper takes as its starting point that the selection of new technologies by firms is not a phenomenon which takes place within a rigid sphere of technical rationality (for example, Rip and Kemp, 1998). Rather, technology forms and diffusion trajectories are driven and shaped by myriad socio-technical structures, interests and logics. A literature review is offered to contribute to a more critical and systemic foundation for understanding the socio-technical features of the selection of LZC technologies in new housing. The problem is investigated through a multidisciplinary lens consisting of two perspectives: technological and institutional. The synthesis of the perspectives crystallises the need to understand that the selection of LZC technologies by housing developers is not solely dependent on technical or economic efficiency, but on the emergent 'fit' between the intrinsic properties of the technologies, institutional logics and the interests and beliefs of various actors in the housing development process.

Keywords: low and zero carbon (LZC) technology, multidisciplinary literature review, new-build housing, zero-carbon new housing.

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DELIVERING ZERO CARBON HOMES IN THE UK

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In the UK and internationally, a plethora of voluntary and mandatory energy efficiency standards for new buildings exist, with the common aim of mitigating the impact of new buildings on climate change. However, the take-up of voluntary schemes has been limited and, as a result, many governments have seen the need to introduce mandatory schemes through legislation; from 2016 all new build homes in England and Wales will be required to achieve zero carbon in regulated energy consumption. The international context of voluntary and mandatory building energy efficiency standards is examined through a review of the literature. The review is expanded by a series of semi-structured interviews with construction professionals involved in the delivery of low and zero carbon homes in the UK. In order to establish why zero carbon homes are not being developed, themes of drivers and barriers and challenges in relation to the delivery of zero carbon homes are explored. The drivers which emerged are categorised into four groups: legislative; economic; social responsibility and individual; and the barriers and challenges into a further four groups: skills and knowledge; legislative and governmental; economic and industry. Skills shortages and knowledge gaps for all involved in the delivery of zero carbon homes were seen as the primary barriers and a gap in the literature also exists in this area. Gaining a greater understanding of the skills and knowledge required for the delivery of zero carbon homes is therefore confirmed as the focus for further research.

Keywords: housing, skills and knowledge, sustainability, zero carbon.

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DELIVERING SUSTAINABLE BUILDINGS IN RETAIL CONSTRUCTION

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The demand for high performance 'green' or 'sustainable' buildings is becoming increasingly important in the retail industry. Large construction companies in this sector have started to show leadership by working with their customers and supply chains towards sustainability in both products and operations. However, it remains unclear how clients' benefits from achieving sustainability can be maximised and the associated risks be minimised, in order to add value and differentiate the output of retail construction. This paper reviews the practice of sustainable buildings within the context of retail construction, and also explores how the UK mainstream retail sector is currently addressing the challenges of sustainable retail buildings. The arguments are informed by a combination of literature review, a desk study of sustainability strategies of large client organisations and construction companies, and a case study with a leading construction company in the UK. The results demonstrate that businesses can benefit from embracing a sustainable approach while they need to adapt their business models to the rapidly changing environment. A demand-driven sustainability agenda is called for in the UK retail sector. The results also provide the basis for an in-depth, longitudinal case study to develop a framework to optimize process, energy and carbon efficiency in retail construction using sustainable technology. Such a framework should provide a sustainable technology model for retail customers to realize the full benefits of sustainable buildings and also assist construction companies and their professional advisors deliver green buildings more efficiently in the future.

Keywords: green buildings, low carbon, sustainable retail construction.

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A CONCEPTUAL MODEL FOR USER-CENTRED PASSIVE BUILDING DESIGN

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The integration of end user factors (EUFs) into passive building design processes is suggested to be of major importance for improving mental health and wellbeing of the building's end-user (E-U). Currently, there is a lack of a robust approach that helps the designer to integrate these factors into the design processes. There is also a need to understand what the most relevant E-U factors are and how to integrate them into passive design processes. Hence, the thesis of this work is to address this challenge by proposing a systemic conceptual E-U centred passive building design model "UCPBDM" that integrates the E-U factors into the PD strategies. The UCPBDM approach is based on ISO 13407 and ISO 9126 standards. Accordingly, we extend the theory of passive design by systemising and incorporating E-U factors. Overall, our investigation builds knowledge by extending E-U centred design theory to passive building design context and by proving a list of effective E-U factors.

Keywords: conceptual modeling, passive building design, quantity surveying, user-centred design, user factors.

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DIAGRAMMATIC REPRESENTATIONS OF SUSTAINABILITY – A REVIEW AND SYNTHESIS

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Models, and in particular diagrams, are frequently used to facilitate the understanding of complex concepts, such as sustainability. Determining the appropriateness of such representations is important if the associated notions are to be understood and related activities to be practically implemented in applicable fields, including the construction industry. An extensive review of existing pictorial models of sustainability was conducted in order to determine their propriety in relation to the sustainability concept. In addition to encompassing the conventional Venn diagram and nested circles depictions, this effort included an inspection of advanced sustainability models. It was determined that none of these diagrammatic representations adequately consider all of the key constituent elements of sustainability, namely: its notional dimensions of environment, society and economy; space and time; and the need for active participation in its implementation. Therefore a synthetic, multi-part visual model was developed to address this perceived deficiency which, when compared with contemporary construction practice, revealed the need for a holistic framework to enable a wider appreciation of sustainability's core principles as applied to the built environment.

Keywords: diagrams, modelling, sustainability.

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