

Institution: University of Wolverhampton
Unit of Assessment: 16 Architecture, Built Environment & Planning
Title of case study: Improving Workplaces Practices in ICT Exploitation and Health and Safety and Time Management
1. Summary of the impact (indicative maximum 100 words)

The types of impact highlighted in this case study are: improved effectiveness of workplace practices in relation to health and safety management, time management and collaborative working; development of resources to enhance professional practice; stimulation of practitioner debate on the impact of new legislation on criminal liability for poor management of health and safety; and improvement in turnover of SMEs through ICT adoption. The mechanisms by which the impact was achieved were KTPs, membership of relevant industry panels and organisation of relevant workshops, CPD events and similar events aimed at practitioners.

2. Underpinning research (indicative maximum 500 words)
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There are three complementary strands to the underpinning research: health and safety risks and competence; shortcomings in time management practices on construction projects; and advances in ICT tools.

Health and safety

The cross-cutting nature of the issues in health and safety has meant that most staff have engaged with them to some extent. In response to the policy of accident prevention through risk assessment, competence and cooperation as stated in the EU Directive 92/57/EEC on Temporary or Mobile Construction Sites, which has been implemented as the CDM Regulations in the UK, much of our effort has gone into models of safety factors, competence and collaboration. For example, research led by Oloke, Hammond, Suresh and Ankrah has produced various models of cost benefit analysis, accident prevention and causal influences of upstream project features (Manu *et al* 2013, Ikpe *et al* 2012). These models have added significantly to knowledge that underpins preventative strategies at the pre-construction stage of projects and accident analysis when prevention fails.

Government passed legislation creating the offence of corporate manslaughter for causing death at the workplace to respond to public outcry about perceived laxity in the law in allowing business “fat cats” to get away with “murder” through their activities. A prong of our health and safety research involved analysis of the new legislation to inform all stakeholders in the construction industry of the risks of a corporate manslaughter conviction (Ndekugri 2013).

Time management Practice

Delayed completion of projects is one of the most protracted challenges facing the construction industry. Not only do clients get their projects late but they are also often embroiled in the most contentious and expensive disputes as to which supply chain member should carry responsibility for the inevitable substantial increase in project costs. Our project time management research highlighted the multi-disciplinary nature of time management (estimators, planners and construction project managers) and shortcomings in planning practice (Ndekugri *et al* 2008, Braimah *et al* 2009). This research informed the parallel research into ICT tools for project planning and collaboration (Zhou *et al* 2012).

Advances in ICT Tools

Our track record in assisting the construction industry to adopt ICT tools heralds back to the early 2000s. Initial work on the use of 4D modelling for space planning under a collaborative EPSRC grant paved the way for much further research as the construction industry moved forward towards BIM (<http://core.kmi.open.ac.uk/display/1932308>). Subsequent research brought together new technologies, including Geographical Information Systems, with Health and Safety for the

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construction industry (Manase *et al* 2011) and collaborative working. Implementation of BIM has been a natural progression. Building on previous work in the field of 3D and 4D modelling of construction processes, the ICT research team have developed new approaches to simulate construction processes using distributed methodologies (Zhou *et al.* 2012). This work developed a completely new software platform to allow distributed 4D planning in an immersive environment (<http://wlv.openrepository.com/wlv/handle/2436/98506>). This has subsequently led to the integration of new approaches to visualising BIM data through Augmented Reality. The integration of our advanced ICT research with research into health and safety, project planning practice and collaboration has been responsible for our outstanding impact on technology adoption.

3. References to the research (indicative maximum of six references)

Braimah, N., Ndekugri, I. (2009). Consultants' Perceptions on Construction Delay Analysis Methodologies, *Journal of Construction Engineering and Management*, American Society of Civil Engineers, 135(12), 1279-1288.

Ikpe, E., Hammond, F. and Oloke, D. (2012). Cost-Benefit Analysis for Accident Prevention in Construction Projects, *Journal of Construction Engineering and Management*, American Society of Civil Engineers, 138(8), 991-998.

Manase, D., Heesom, D., Oloke, D., Proverbs, D., Young, C., and Luckhurst, D. (2011). A GIS Analytical Approach for Exploiting Construction Health and Safety Information, *Journal of IT in Construction*, 16(2011), 335-356.

Manu, P., Ankrah, N., Proverbs, D. and Suresh, S. (2013) Mitigating the health and safety influence of subcontracting in construction: The approach of main contractors, *International Journal of Project Management*, 31(7), 1017–1026.

Ndekugri, I., Braimah, N. and Gameson, R. (2008). Delay Analysis within Construction Contracting Organisations, *Journal of Construction Engineering and Management*, American Society of Civil Engineers, 134(9), 692-700.

Zhou, W., Georgakis, P., Heesom, D. and Feng, X. (2012). Model-based groupware solution for distributed real-time collaborative 4D planning via teamwork, *Journal of Computing in Civil Engineering*, 26 (5), 597-611.

All the above research publications are in some of the most rigorously peer-reviewed international journals for the discipline. They are therefore of, at least, 2* quality.

4. Details of the impact (indicative maximum 750 words)

Knowledge Transfer Partnerships

Our work on the implementation of BIM for prefabrication led to a KTP with Banro Holdings Ltd. which transformed the company's working practices and aided it in increasing the number of projects they could handle, whilst improving efficiency of prefabrication projects within the company. The project was independently assessed as grade B (Very Good) by reviewers. Benefits included a substantial profit increase (http://www.ktponline.org.uk/case-study-search/862/KTP_BanroHoldings_754.pdf).

In 2010 our research in the BIM area led to the establishment of a highly successful KTP with Severn Partnership Ltd. and the practical implementation of 3D modelling and Scan2BIM within the company. As a consequence of the KTP, the company is now one of the leading suppliers of Scan2BIM for the construction industry. The company's reach went global, resulting in increased turnover and profitability (<http://www.wlv.ac.uk/default.aspx?page=33962>) (References 1 & 2). The

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project was shortlisted for two business awards and received a Grade A (Outstanding) from the independent review process.

Building on our Augmented Reality and BIM research, a second KTP was successfully established with Severn Partnership and is currently on-going. Results from this KTP are already extremely positive and a new sister company has been established based on the work undertaken (<http://www.seeable.co.uk>). We have just won a new KTP to focus on the application of ICT to enhance health and safety in the rail sector. This work will further bring together our research in the areas of BIM, Augmented Reality and Health and Safety.

Our expertise in the field of BIM is now having significant regional and national impacts on the construction industry. In the last 24 months we have operated a substantial number of Innovation Vouchers funded by the TSB. These have assisted companies in developing BIM implementation strategies. We have held conferences on BIM implementation (http://www.ciat.org.uk/en/media_centre/news_and_events/events.cfm/freebimfree#.UmAidmTJEuc) for the construction industry and Heesom now sits on several committees, including the CIAT national BIM group and the Midlands BIM Hub. In addition, the expertise derived from our research activities within the field of BIM has led to an on-going collaboration with the Construction Industry Training Board (CITB) and the National Construction College (NCC) to deliver state-of-the-art seminars on the topic around the UK (for example, see <http://www.fmb.org.uk/grow-your-business/training/green-building/building-information-modelling>) Over 30 seminars have been delivered all over the UK to over 600 construction practitioners (Reference 3).

CPD and Training

Over 150 construction professionals have been trained through various CPD programmes organised by the then UK West Midlands Centre for Constructing Excellence (WMCCE), the University of Wolverhampton, the Council for the Regulation of Engineering in Nigeria (COREN) and the Abu Dhabi Police Force, UAE (Reference 4).

Stimulation of Practitioner Debates

One of the principal ways of achieving this impact has been through membership of key decision-making bodies in industry. For example, Oloke has been a member of the ICE Health and Safety Expert Panel since 2005 (Reference 5), a role through which he participates in the work of several practice sub-panels and contributes to topical issues (e.g. the on-going consultation towards revision of the CDM Regulations). He is the current Chairman of the ICE's Health and Safety Register Working Group, which has the delegated authority of developing and promoting policies for the ICE Construction Health and Safety Register. Practitioner debate has also been stimulated by our team's contributions to workshops for practitioners. Sometimes publications come to the attention of the professional institutions and they are found important enough to warrant a Press Release either to influence the practice of their members or stimulate debate. Our work on corporate manslaughter exemplifies this type of impact. The ICE found the outcomes of Ndekugri's study (Ndekugri 2013) so instructive to consulting engineers that they issued a Press Release bringing it to the attention of their members (Reference 6).

Contribution to Best Practice Guidelines

Our health and safety research has made a very important contribution to the ICE in their development of guidance on best practice in health and safety management, which is now available as a manual (Reference 7). Oloke also contributed extensively to the development of the London 2012 Safety, Environmental and Health Manual for the procurement of the infrastructure for the 2012 London Olympics (Reference 8). Our work on delay analysis has been incorporated by the International Association of Advances in Cost Engineering into their practice guidance on forensic analysis of delay (Reference 9).

5. Sources to corroborate the impact (indicative maximum of 10 references)

- 1 Contact information for a person who may be approached to corroborate the statement on business performance: Mark Combes, BSc (Hons), MRICS, MCIInstCES. Managing

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Director. The Severn Partnership Ltd, The Maltings, 59 Lythwood Road, Bayston Hill, Shrewsbury SY3 0NA

- 2 For KTPs with Severn Partnership see: Knowledge Transfer Partnership Final Report (2012) - 3D modelling with 3D Laser Scanning. Partnership between the University of Wolverhampton and Severn Partnership. <http://info.ktponline.org.uk/action/details/partnership.aspx?id=7580>; University of Wolverhampton Case Study – The Severn Partnership Ltd. (2012) <http://www.wlv.ac.uk/default.aspx?page=33962>; Integrating RFID with BIM - Knowledge Transfer Partnership between the University of Wolverhampton and Severn Partnership. <http://info.ktponline.org.uk/action/details/partnership.aspx?id=8830>.
- 3 Contact information for a person who may be approached to corroborate the statement about this activity: Liz Burnett Project Co-ordinator - Leadership & Management Team National Construction College Bircham Newton, King's Lynn Norfolk, PE31 6RH
- 4 1st.Lt.Eng Sultan Rashed Alkitbi Director Office Manager Engineering project administration Abu Dhabi police GHQ; Tharinda Rathnapala/ Business Process Manager Ash and Lacey Bromford Lane West Bromwich West Midlands B70 7JJ
- 5 Dr Oloke's membership of the ICE Health and Safety Register (Working Group Chair) <http://www.ice.org.uk/getattachment/6155f4fd-5416-4172-88ff-5000edd06d24/RGN-9---ICE-Health--Safety-Register-current-regis.aspx>.
- 6 Ndekugri, I. (2013). The consulting engineer and corporate manslaughter risk, *Proceedings of the Institution of Engineers, Management, Procurement and Law*, 166(3), 128-136. ICE Press Release: <http://www.ice.org.uk/topics/management/Virtual-Library/Consultants-warned-of-manslaughter-risk> (accessed 08/10/2013).
- 7 McAleenan, C. and Oloke, D. (Eds) (2010) *ICE Manual of Health and Safety in Construction*, ICE Publishing, London. Hardbound ISBN: 978-0-7277-4056-4; E-book ISBN: 978-0-7277-4121-9; Publication Date: June 2010; DOI: 10.1680/mohs.40564; Format: Hardbound, Electronic. <http://www.icevirtuallibrary.com/content/book/101139> .
- 8 Dr Oloke has been issued with a certificate in appreciation for his contribution to health and safety management of the construction projects for the 2012 London Olympic Games.
- 9 See www.aacei.org/resources/ppg/toc/toc_4060-28.pdf (accessed 18 October 2013).