

Impact case study (REF3b)

Institution:	Loughborough University
Unit of Assessment:	C16 Architecture, Built Environment and Planning
Title of case study:	The ConCA framework for understanding accident causation and preventing construction accidents
<p>1. Summary of the impact (indicative maximum 100 words)</p> <p>Loughborough University's Construction Accident Causality (ConCA) framework has:</p> <ul style="list-style-type: none"> • Significantly contributed to the Health and Safety Executive's (HSE) programme towards major improvements in construction health and safety over a 10-year period; • Influenced the direction of the Donaghy Inquiry into fatal accidents and its implementation; • Underpinned the framework for evaluating the underlying human and organisational factors for the Olympic Delivery Authority's exemplary health and safety record for London 2012. • Helped in the development by HSE of a new approach to construction-accident investigations; • Guided Toyota Australia in an investigation of a construction fatality; and, • Shaped the work of an HSE-industry-trades-union working party on dealing with the risk of catastrophic construction incidents. 	
<p>2. Underpinning research (indicative maximum 500 words)</p> <p>In the UK, construction kills and injures more people than any other industry. The causes of accidents are numerous and combine in complex patterns. Many accidents go unreported and few construction companies are sufficiently equipped to investigate and learn from accidents. The Health and Safety Executive (HSE) approach to construction accidents is dictated as much by its duty in law enforcement as to improving health and safety.</p> <p>Until 2000, researchers of construction accident causes mainly focussed on accident frequency and patterns of incidence. When, rarely, they analysed accident data more deeply, they concentrated on the immediate accident circumstances, neglecting indirect underlying influences more remote from the accident location.</p> <p>Loughborough University's ConCA was the first readily applied framework to redress the balance in our understanding of what causes construction accidents between the indirect (distal) and direct (proximal) causes and, at the same time, accord due weight to the complexity of construction-accident causation, with interlinked factors operating simultaneously at different levels of the hierarchy. Understanding what really causes accidents is the first major step towards preventing them in the future. Loughborough University's interdisciplinary project (ConCA) began in 1999 to gather rich data on 100 construction accidents with sensitivity to an exceptionally broad range of causal factors. The researchers won HSE funding from HSE's 1998-99 Competition for Ideas.</p> <p>A trio of researchers led the project – Alistair Gibb, then a senior lecturer (now Professor) in the Department of Civil and Building Engineering (DCBE) (93 to date); Roger Haslam, lecturer (now Professor) in the Department of Human Sciences (DHS) (92 to date, now in Design School); and Diane Gyi, research development fellow (now Reader) in the Department of Design and Technology (93 to date). Research student Hide (DCBE 99-03) developed the research methods, collected data and made a detailed analysis of 40 of the 100 accidents, obtaining her PhD in 2003. Loughborough University research assistants Pavitt (DCBE 98-04) and Atkinson (DHS 99-01) collected and analysed data for the remaining 60 accidents.</p> <p>Through their analysis, the team devised a hierarchical model of construction-accident causality distinguishing originating influences, shaping factors and immediate accident circumstances. For each of these, represented as layers in the model, they identified the types of causal factor typical of construction accidents [R1, R2, R3, R4].</p> <p>With the ConCA model in place, the team were able to identify and highlight specific causal chains of concern away from the immediate circumstances and make corresponding recommendations to the industry such that, by applying these more accidents would be prevented. The HSE published</p>	

the findings in report RR156 [R2]. The researchers have published succinct accounts of their model and its implications in academic literature [R3] and publications read by practitioners [R1].

In 2009, Gibb led a team including DCBE research associates Pendlebury 2000-2009, Bust (2003 to date) and Brace (DHS, 2003 - 2006) in a review of international research on the causes of fatal construction accidents for an inquiry commissioned by the Secretary of State for Work and Pensions into the underlying causes of fatal construction accidents ('Donaghy inquiry'). The team based its approach on the ConCA model. The HSE published the team's findings [R5]. In 2010, Gibb used the ConCA model as the foundation for an HSE-funded investigation of the risk of catastrophic incidents in construction. The HSE published the findings in its Research Report series in 2011 [R6]. Two colleagues formed part of Gibb's team – senior lecturer Lee Boshier (DCBE 05 to date) and research assistant Kappia (DCBE, 2008-10). Gilbertson of the Construction Industry Research and Information Association (CIRIA) was an industrial collaborator.

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

- R1 Gibb, A., Haslam, R., Gyi, D., Hide, S. and Duff, A. (2006) "What causes accidents?", *Proceedings of the Institution of Civil Engineers – Civil Engineering*, 159(6), 46-50, DOI: 10.1680/cien.2006.159.6.46, ISSN 0965 089 X <http://hdl.handle.net/2134/5729> (Top peer-reviewed Civil Engineering Journal maximising impact as delivered FOC to every chartered Civil Engineer) (won the Institution of Civil Engineer's Safety in Construction Medal for 2007. See *Proc Institution of Civil Engineers*, August 2007, 160(3), p. 109 DOI: 10.1680/cien.2007.160.3.104) [impact factor 0.125, 16 citations]
- R2 Hide, S., Atkinson, S., Pavitt, T., Haslam, R., Gibb, A., Gyi, D., Duff, R. and Suraji, A. (2003) "Causal factors in construction accidents", *HSE Research Report RR 156*, ISBN 07176 2749 7, (www.hse.gov.uk/research/rrpdf/rr156.pdf) [11 citations, research undertaken wholly by Loughborough University, with UMIST acting purely as advisor]
- R3 Haslam, R., Hide, S., Gibb, A., Gyi, D., Pavitt, T., Atkinson, S. and Duff, A. (2005) "Contributing factors in construction accidents", *Applied Ergonomics*, 36(4): 401-415. DOI: 10.1016/j.apergo.2004.12.002 (Invited paper, special edition on ergonomics in building and construction – 2nd most downloaded paper via Science Direct from *Applied Ergonomics* in 2005 for all previous years) [impact factor 1.428, 143 citations]
- R4 Gibb, A., Hide, S., Haslam, R., Gyi, D., Pavitt, T., Atkinson, S. and Duff, A. (2005) "Construction tools and equipment – their influence on accident causality", *Journal of Engineering, Design and Technology*, 3(1): 12-23. DOI: 10.1108/17260530510815303 (Published in a peer-reviewed journal) [SCImago Journal Rank 0.251, 8 citations]
- R5 Brace, C., Gibb, A.G.F., Pendlebury, M. & Bust, P.D. (2009), "Health & Safety in the Construction Industry: Underlying causes in construction fatal accidents – External research", *Health and Safety Executive, HSE Report*, 205 pp, www.hse.gov.uk/construction/resources/phase2ext.pdf
- R6 Gilbertson, A., Kappia, J., Boshier, L. & Gibb, A.G.F., (2011) "Preventing catastrophic events in construction", *HSE Research Report RR834*, Health & Safety Executive, HSE Books, 220pp, <http://www.hse.gov.uk/research/rrhtm/rr834.htm>

Grants/funding awarded

- G1 Gibb & Haslam; London 2012: *Preconditioning for Success (Human & Organisational factors evaluation)*; HSE; 2011-12; £99k
- G2 Gibb & Cheyne; *Olympic Park Safety and Communication Initiatives*; IOSH; 2011-12; £131k
- G3 Gibb & Boshier; *Catastrophic Events in Construction*; HSE (via CIRIA); 2009-10; £29k
- G4 Gibb & Cheyne; *London Olympics – Effectiveness of H&S Interventions*; IOSH; 2009-10; £5k
- G5 Gibb; *What Causes Construction Fatalities? (part of the Donaghy Enquiry)*; HSE; 2009; £73k
- G6 Gibb; *Prevention through Design* (2 contracts); NIOSH (USA); 2008-10; £55k
- G7 Gibb & Dainty; *Migrant Workers – H&S Communication*; ConstructionSkills; 2008-09; £70k
- G8 Gibb & Richardson; *Older worker issues for H&S*; EPSRC (via IMCRC); 2007-09; £150k

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- G9** Gibb & Pasquire; *Global worker issues for H&S* (2 projects); EPSRC (via IMCRC); 2004-07; £114k
- G10** Gibb; *Project Excellence issues for H&S*; Association for Project Safety; 2004; £13k
- G11** Gibb & Haslam; *Offsite issues for H&S (HASPREST)*; DETR/EPSRC IMI MCNS; 2001-04; £200k
- G12** Gibb & Haslam; *Site and Personal factors in Accident Causation in Construction*; HSE; 1999-2002; £114k

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

ConCA work has significantly improved the understanding of what really causes construction accidents, as a major step towards preventing their occurrence.

In 2001, the Health and Safety Executive (HSE) established a ten-year work programme to make a significant improvement to health and safety in construction owing to the sector's poor health and safety performance. HSE acknowledge that, from its publication in 2003, the ConCA report RR156 was "*particularly relevant to the establishment and development*" of this HSE programme, "*leading to a number of initiatives being taken forward to target specific activities and risks*". The ConCA model's high-level similarity to an influence-network model that emerged from other HSE-sponsored research in particular gave HSE's Construction Division confidence to take account of all levels in the model hierarchies. Its synoptic sensibility has prompted several initiatives targeting specific risks; it persists today [C1, C2].

In 2009, the Loughborough University team's record led the HSE to commission it to review construction-safety research in order to inform the Donaghy 'Fatales' Inquiry, which the HSE was supporting. As HSE note [C2], "*On these occasions it is important that those leading the enquiries are furnished with appropriately robust data and analysis. Loughborough University's work in support of phase one of the enquiry provided a consolidated view of previous work on causal factors as a platform for later stages*". Loughborough University researchers influenced the inquiry directly through one of two foundational reports published as part of the inquiry. But more important was an indirect influence through the lasting impact within HSE's Construction Division of Loughborough University's ConCA research. HFACS-C, the method of examining the underlying causes of fatal construction accidents adopted by Donaghy draws on ConCA, notably for the breadth of causal factors it recognizes [C3].

The current Secretary of State for Work and Pensions has said that "*The Government are committed to addressing the heavy toll of deaths in the construction industry which was highlighted in Baroness Donaghy's report. We will therefore progress those of the Donaghy recommendations accepted by the previous Administration*", including, for example, simplification of pre-qualification for small firms tendering for publicly-funded construction work [C4].

HFACS-C is a version of HFACS, an aviation accident-investigation framework first applied to construction accidents by the HSE in 2007. HSE's development and use of it continues today. HSE's Health and Safety Laboratory used it in a 2012 study, for example, of good safety practice in the putting up and taking down of temporary demountable structures (TDSs). HSE commissioned the research and published the resulting report [C5] in anticipation of the high demand for TDSs they knew would occur for the London 2012 Olympic and Paralympic Games. The London 2012 Games have since been celebrated for their exceptionally good health and safety record (zero fatalities and an accident rate six times better than the industry average).

In 2009, concerned about a perceived neglect by industry of the risk of catastrophic construction incidents, the HSE commissioned Gibb and Loughborough University colleagues to extend their causality work to examine this risk with the Construction Industry Research and Information Association (CIRIA) 'with a view to challenging industry to address issues which appeared to offer the best chance for improvement in performance'. In parallel with publication of the findings by HSE in Research Report 834, April 2011 [R6], CIRIA published *Guidance on catastrophic events in construction* (CIRIA, <http://bit.ly/1fld2SZ>), which supplemented material from RR834 [R6] with material calculated to help practitioners respond practically to RR834. Publication followed a series of feature articles published in *New Civil Engineer* about the catastrophe research, which helped

attract industry attention to this issue. Recommendations from Loughborough University's catastrophe work "are now being taken forward by a working group established by the Construction Industry Advisory Committee (CONIAC) – a tri-partite committee of HSE, industry and trades unions" [C2]. CONIAC advises HSE on protecting people from construction-related health and safety hazards.

The reach of ConCA has extended beyond both the construction industry and the UK. For example, after a fatality during construction of a new building in an upgrade to its manufacturing plant, Toyota Australia searched for a model that would best guide them through a construction-accident investigation, they consulted Royal Melbourne Institute of Technology (RMIT) University in Melbourne and were "advised that the ConCA accident causation model... would be able to assist [them] in [their] investigation". They "found the model useful in exploring both direct and indirect causes of the accident, thus allowing better insight into how the accident occurred" [C6].

On the strength of their reputation, Gibb and Loughborough University colleague Haslam (DHS), with industry subcontractor Helen Bolt, were commissioned by the Olympic Delivery Authority's (ODA) to document the human and organisational contributions to the exemplary construction health and safety performance achieved by the ODA at London 2012. The subsequent report made publicly available on the ODA's Learning Legacy website, provides examples to convey in practical terms the key factors that contributed to the health and safety achievement. Howard Shiplee, the ODA's Construction Director commented, "of all the 2012 Legacy Learning documents I really believe this to be the most significant for the future. May I thank you... for doing such a terrific job in setting out with credibility the significance of 'soft' individual and organisational issues which can transform the construction industry". Furthermore, "Preconditioning for Success' is not just a roadmap provides real guidance for those embarking on any project or programme in the future" [C7].

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

The following sources of corroboration can be made available at request.

- C1 HSE 2010 Construction Intelligence Report – Analysis of Construction Injury and Ill Health Intelligence, http://s3.amazonaws.com/zanran_storage/www.hse.gov.uk/ContentPages/25543732.pdf (Shows the persistence of the ConCA research)
- C2 Letter 'THE IMPACT OF RESEARCH ON HSE'S WORK' from Head of Operations, North West England, Field Operations Directorate, Construction Division, Health and Safety Executive (HSE). (States the influence of Loughborough University research on HSE policy and procedure - A copy of this letter, complete with signature, is available)
- C3 HSE Construction Division *Phase 1 Report: Underlying causes of construction fatal accidents – A comprehensive review of recent work to consolidate and summarise existing knowledge*, July 2009, Health and Safety Executive, HSE Report (shows ConCA was key in the development of the model developed by HSE for investigating fatal accidents) <http://www.hse.gov.uk/construction/resources/phase1.pdf>
- C4 Written answer from Secretary of State for Work and Pensions to question from Miss Begg on 'Industrial Accidents: Construction', Written Answers for 01-Dec-2010, Hansard, Column 867W (Further HSE work on London 2012 showing the impact of Loughborough University's ConCA)
- C5 Bell, J., Binch, S. and McCann, P. *Identification of safety good practice in the construction and deconstruction of temporary demountable structures*, 2012, Health and Safety Laboratory Report, 157 pp, (shows, despite the Government change, Loughborough University's work is still influencing change) <http://www.hse.gov.uk/event-safety/demountable-structures.pdf>
- C6 Letter 'Re Accident Causation Model' from National Occupational Health and Safety Manager, Toyota Motor Corporation Australia (Confirms that Loughborough University's ConCA framework was used in the analysis and to learn for the future following a fatal accident - A copy of this letter, complete with signature, is available)
- C7 Olympic Delivery Authority Construction Director [Personal email 2012 and public speech 2013] (ODA Director's acknowledgement of significance of Loughborough University work in learning from and driving legacy changes from London 2012)