Institution: Newcastle University

Unit of Assessment: 16 Architecture, Built Environment and Planning

Title of case study: Information Modelling and Application Development for Improved Construction Industry Practices

1. Summary of the impact

Research in information modelling at Newcastle University's School of Architecture, Planning and Landscape, supported by research grants and industry funding, led to the development of a software prototype and subsequently to a market software application (NBS Scheduler). This product is particularly targeted at SMEs in the construction industry with a design capability and for them it has become best-practice software. The product – developed and marketed by National Building Specification (NBS, an arm of the Royal Institute of British Architects) – has transformed the organisation, writing and formatting of non-drawn information for refurbishment and smaller new-build projects. It has made a significant contribution to developing accurate building project information with subsequent commercial and societal benefits through the lowering of transaction costs and prices. Scheduler has also underpinned the development of another product (NBS Create), which also leads its field through the creation of Building Information Modeling (BIM)-compliant building specifications.

2. Underpinning research

This case study is underpinned by a wide body of construction informatics research but specifically research into the development of models to automate the building specification process and facilitate its link-up with other building design information. Of particular relevance is the work by staff in the Construction Informatics Research Centre/Architectural Informatics Group at Newcastle University between 1990 and 2002, particularly Stephen Lockley (RA, Lecturer and Professor, 1985–2002, Visiting Professor 2013-), Ming Sun (RA and Lecturer, 1990–1996), Richard Watson (RA and Lecturer, 1999–2002) and Sameh Shaaban (RA, 1999–2002).

The design and construction of buildings involves a wide range of professionals and firms that work together in unique 'one-off' projects to create buildings and other assets. The involvement of many firms allows for flexibility and the scope to put together the best mix of skills to deliver any project. However this fragmented structure can lead to problems in the sharing and exchange of information between different professionals and the software applications used by them. The need to 'integrate' the construction industry through, for example, the development of standard ways of working, and software applications that are interoperable (i.e. share and exchange information seamlessly), has therefore been a longstanding and on-going need in the industry.

A key strategy in such construction integration is the use of Information and Communication Technologies to: automate discrete activities in the design and construction process; develop models and standards for the representation and communication of building information between people and different software applications; and facilitate 'virtual' collaborative working and the conduct of business electronically.

In the early 1990s, Newcastle University was a key member of the Europe-wide COMBINE (Computer Models for the Building Industry in Europe) 1 and 2 projects, which were aimed at developing: workable computer integrated building design systems; robust exchange systems for building models, cost estimating tools, and the implementation of building component database prototypes. Newcastle's involvement in the COMBINE 2 project (1993-1995) was to develop a "Data Exchange System which provides the underlying support for data exchange and data maintenance in an integrated building design system…" **(1, 2)**.

Industry became interested in the outputs from this research and there followed a period from 1995 to 2002 when more commercially-oriented research and development was undertaken by

Newcastle staff with funding from RIBA Enterprises (National Building Specification) in particular. As Watson, Lockley and Shaaban describe **(3),** this was "to support the creation, management and communication of project specification information": "information that is communicated by the design team to the contractor to enable the construction of a building project". Research activity in this area focused on "the creation and population of appropriate, re-usable information models…to provide a generic information resource for the industry" **(3)**.

The outputs from this research directly led to the development of several industry applications in conjunction with the National Building Specification (NBS), who provided funding for these developments**.** In 2002 many members of the Newcastle University group became employed by NBS to continue the development of software products based on their earlier research. The impact case study described below focuses on two of the products (NBS Scheduler, and subsequently, NBS Create) that resulted from the underpinning research.

3. References to the research

1) Lockley, S.R**.** (1995), "A building server for a construction industry client," In Brandon, P. and Betts, M. (eds.) *Integrated Construction Information*, E & FN Spon, London, p233-250. Available on request.

2) Sun M. and Lockley S.R. (1997), "Data exchange system for an integrated building design system," *Automation in Construction*, 6(2):147-155. Available at: http://dx.doi.org/10.1016/S0926-5805(97)00015-0.

3) Watson, R., Lockley, S. R., and Shaaban, S. (2002), "Creating usable models for re-usable data - managing electronic project specification Information," *Engineering, Construction and Architectural Management,* 9(3):272-283. Available at: http://dx.doi.org/10.1108/eb021222.

Grant and Project Information:

RIBA Enterprises (National Building Specification): (various grants between 1995 and 2002): Integration Construction Information Systems (value: £2,171,153)

European Union - JOULE: COMBINE 1 and 2: Computer Models for Building Industry in Europe (1990-1993 and 1993-1995, respectively)

4. Details of the impact

As a direct result of the underpinning research, two products, NBS Scheduler and NBS Create, were developed by NBS. Both have impact in the 2008–2013 period, NBS Scheduler as a continuation and development of its initial impact and NBS Create as a new product impacting on professional practice. Both products are targeted at SMEs (although NBS Create is used by large companies as well) which need to work seamlessly to provide high quality buildings, sometimes in collaboration with large construction firms which usually have dedicated in-house facilities. Each product allows the incorporation of up-to-date industry standards, regulations and codes for the UK and represents rare examples of University-developed prototypes making it not only to market, but to become market leaders.

NBS Scheduler

NBS Scheduler is marketed by NBS and was launched in 2001. It enables users to write schedules of work for refurbishment, alteration and new-build projects without bills of quantities, and facilitates the creation of a three-part document consisting of preliminaries, a specification and priceable schedule of work for use on building projects. NBS Scheduler is designed to deal with smaller construction projects and is thus targeted at small to medium firms, which constitute the majority of firms in the construction industry (RIBA estimate that small architectural practices (with less than 6 employees) constitute three quarters of the UK total **(3)**). These firms usually do not have the resource to develop bespoke software for such tasks (which are time-consuming and can lead to errors and delays on projects if not written accurately). The facility to use products like Scheduler is therefore a tremendous benefit to a key component of the UK economy, as it allows firms to quickly

develop construction information in a structured and standardised format that is compatible with other building related software (e.g. AutoCAD). Clients subscribe to the service which allows continuous updates from the national standard specification system for the UK. The impact of the software was immediately apparent and by 2011, 570 British firms had a current subscription for the software with subscriptions to Scheduler accounting for c.£300,000 income per annum **(IMP1)**.

One of the users of NBS Scheduler is Architectural Co-operative, which works with communities to improve the design and construction of the built environment. They use the software to complete domestic refurbishment projects. Their director confirms that NBS Scheduler enables them to write schedules of work quickly and easily and keeps them up to date with the latest British standards, contracts, building regulations and codes since the software is designed to be regularly updated **(IMP2)**. Robert Turner of Robert Turner Associates (a Chartered Building Surveying practice) confirms that his business "has benefited enormously by using NBS Scheduler" because it has "aided in eliminating oversights in the specification" and minimised "the risk…of…specification writing [allowing] the specifier to concentrate on the task in hand" **(IMP3)**; and The Martin Design Partnership (an architectural design consultancy) use NBS Scheduler for its ease of use and ability to produce schedules quickly and accurately. They affirm that in order to maintain their high standards of documentation, they rely on NBS Scheduler for producing high quality accurate schedules **(IMP4)**. Other companies like MDBCS **(IMP5)** (building surveying), and Russes and Turner (architectural design) have also acknowledged that in order to maintain their high standards of documentation, they rely on NBS Scheduler for producing high quality accurate schedules.

The reach and significance of NBS Scheduler in the UK Construction industry is further demonstrated by the fact that drawing and modelling software developers such as ArchiCAD have developed tools to communicate with NBS Scheduler which makes NBS Scheduler available with just a mouse-click from ArchiCAD **(IMP6)**. Further evidence of the reach of this software is that producers of different materials and construction related items find it advantageous for them to be included in the database of NBS Scheduler and they mention this on their advertisements and websites: e.g. Neaco, FAKRO, CMS ACOUSTICS, Axess2, Bituchem Asphalt LTD, and Stratatiles **(IMP7)**.

NBS Create

In addition to the direct impact created through the use of NBS Scheduler, the research underpinning its development has also led to the development of a more recent software product (NBS Create), launched in 2011 to the engineering services market, with releases of architecture, structure and landscape libraries in March 2012. The Executive Director for RIBA Enterprises states that: "the information modelling undertaken for NBS Scheduler…served as a platform for the development of the new NBS Create product," and is based on "the underlying information model that is an extension/development of the model in [NBS] Scheduler" **(IMP8)**. In a website description, he expressed his belief that NBS Create "is the most advanced specification modelling system in the world" **(IMP9)** and his view has been endorsed by the industry: in the 2013 Construction News Awards, NBS Create won the Digital Built Britain Award **(IMP10)**. The Executive Director of RIBA goes on to say that it is a "built-for-BIM [Building Information Modelling] specification system"; which "…meets both the current needs for a flexible specification system…and delivers information in the structured format required for BIM" **(IMP9)**. As at June 2013, 235 companies had current subscriptions for this product **(IMP8)**. One of the subscribers (EPR Architects) comments that it allows them "to write comprehensive and technically proficient specifications", and "improves the efficiency of the [design, construction detailing and specification] process and reduces the opportunities for mistakes" **(IMP2)**.

Both NBS Scheduler and NBS Create represent exemplars of how academic research can develop into prototypes and then marketable products. These software products are widely used by small firms in the industry and have made invaluable improvements to their practices. The underpinning research is therefore making a sustained impact in the UK construction industry and thus the productivity of the wider UK economy.

5. Sources to corroborate the impact

IMP1 NBS survey results 2011 (Confidential).

IMP2 Personal communication from Director, Architectural Co-operative.

IMP3 Personal communication from Robert Turner Associates.

IMP4 The Martin Design Partnership brochure. Available at: http://www.themdp.co.uk/mdpbrochure.pdf.

IMP5 MDB Chartered Surveyors website. Available at: http://www.mdbcs.co.uk/education.html.

IMP6 Building Industry Membership website news. Available at: http://www.bim.me.uk/news.php?subaction=showfull&id=1328714844&archive=&start_from=&ucat=6&.

IMP7 See for example, Stratatiles website. Available, at: http://www.stratatiles.co.uk/nbs-plus/.

IMP8 Personal communication from Executive Director, RIBA Enterprises.

IMP9 Richard Watson description on the NBS website. Available at: http://www.thenbs.com/topics/designspecification/articles/futureofspecification.asp.

IMP10 Construction News Award Winners. Available at: http://www.cnplus.co.uk/home/awards/construction-news-awards-2013-winners-revealed/8650564.article.