REF2021

Institution: University of Northumbria at Newcastle	
Unit of Assessment: 13 (Architecture, Built Environment and Planning)	
Title of case study: Improving planning assessment and development for sensitive cityscapes via interactive virtual city models	

Period when the underpinning research was undertaken: January 2000 - December 2020

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
James Charlton	Senior lecturer	01/09/2012 – present
Bob Giddings	Professor	01/09/1987 – 31/10/2020
Paul Greenhalgh	Professor	01/09/1992 – present
Kevin Muldoon-Smith	Senior lecturer	01/10/2015 – present
Emine Thompson	Senior Lecturer	12/09/2005 – 31/07/2017
Margaret Horne	Enterprise Fellow	01/09/1990 – 31/08/2012

Period when the claimed impact occurred: August 2013 - December 2020

Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact (indicative maximum 100 words)

When assessing the impact of proposed new developments, urban planners need to pay special consideration to preserving or enhancing the characteristics of sensitive cityscapes, a complex exercise that traditionally has relied on static visualisations. Research into virtual city modelling at Northumbria has developed novel digital solutions, which have been applied to conurbations in the North East of England: Virtual NewcastleGateshead (VNG) and Virtual Sunderland (VS). These innovative tools have provided city planners with the ability to conduct comprehensive assessments of the visual impacts of a development against current and future cityscapes. The insights provided efficiencies that have saved time, money, and created a more effective process for assessing and marketing key planning applications. Since 2013, the research has improved the assessment of 20 major developments throughout North East England, valued in total at over GBP1,300,000,000. The virtual tools now feature as embedded elements within local authority planning policies across the North East, informing key strategic plans, including a central government-backed Foresight Programme that will also shape long-term national strategy regarding future development.

2. Underpinning research (indicative maximum 500 words)

3D cityscapes or virtual city models (VCMs) are increasingly used to manage urban development, with the integration of diverse types of data helping to improve usability and assessment. One key area of application is with the planning process, which plays an important role in protecting, preserving, or enhancing the unique characteristics and appearance of visually sensitive cityscapes. However, this extremely complicated exercise is often constrained by limited resources for accurate assessment and limited opportunities for applicants to show a variety of viewpoints. The resulting representations may be biased and partial, ultimately leading to a potential for lasting damage to visually sensitive cityscapes. To address these issues, the Digital Built Environment research group (DBE) at Northumbria University developed innovative, real-time, and flexible visualisation techniques, which integrate VCMs with useful urban datasets, including identifying buildings of historic relevance [**R1**-**R5**]. These techniques provide a more impartial, accurate, and comprehensive assessment of the visual impact of a development against current and future cityscapes.

The DBE groups' exploration of virtual reality (VR) adoption and 3D modelling within the architectural, engineering, and construction industries, established the potential benefits for VR adoption and the barriers preventing it (specifically the time required to create 3D models) [**R1**]. This work identified the VCM as a solution to help overcome the outlined challenges, by delivering an effective VR experience. Research into the use of smaller scale VCM to support

VR experiences of individual sites, paved the way for the application of a larger scale model covering an entire city, to support urban planning assessment [**R1**].

Further research defined the ideal requirements of a virtual city model for city authorities (urban planning and design), citizens (public participation), and practitioners (architects and developers). These studies critically examined available technologies, remote access issues, collaboration, and version control [**R2**]. The work led to the original iteration of the virtual city model of Newcastle and Gateshead, Virtual NewcastleGateshead (VNG).

A challenge for many early VCMs is that they were often created for a single application and would therefore quickly become obsolete; for VCMs to be useful they need to remain relevant and up to date. The DBE group subsequently identified obsolescence factors for VCMs, including the need for continual updating through strategic collaborations between multiple organisations, to maintain the currency of VCMs over time [**R3**]. As a solution, the research highlighted the need for a more multifunctional approach to improve the sustainability of VCMs, aligning the development of 'real' cityscapes to assess urban planning proposals visually and analytically. This considered 'layering' models with data for visualised simulations of the performance of urban spaces – including movement, noise, wind, and thermal comfort – and consequent issues of data as well as software interoperability [**R3**].

The DBE group, now led by Dr James Charlton, continued to work with councils in Newcastle, Gateshead, and later Sunderland, to develop pioneering digital tools to help protect the historic low-rise architecture and the city image and cityscape associated with these urban areas [**R4**, **R5**]. The research was funded by all three councils (Newcastle, Gateshead, and Sunderland), and developed novel methodologies for the optimisation, application, and integration of VCM with urban datasets to support the largest city developments. The research improved interoperability and management of VCM, particularly those with challenging, city-scale assessment criteria, by establishing the appropriate level of detail and file formats to support effective storage, management, and application [**R4**, **R5**]. This work demonstrated how adding data layers to an VCM can improve functionality, allowing planners to consider the relationship between historic buildings and newly proposed ones. The VNG for example, can single out architectural features and identify listed buildings, and improved visual outputs enable recognition of diverse features, enabling bespoke and tailored solutions. Although the increased detail can lead to challenges as a result of high volumes of data, the VNG provides a balance between operability and detail, enabling planning assessment that is sufficiently flexible to allow interoperability with other systems such as those used by architects [**R4**, **R5**].

Since 2012, research by Charlton and his colleagues has enhanced the VNG, making it more relevant and applicable with each iteration. Major revisions to the model have been released every four years since 2009, with the next update confirmed for 2021. Incremental updates to the urban form are also added continually as new proposals go through the planning system [**R3**-**R5**]. This feature has enabled planners to both carry out assessment in an up-to-date model, but also model future developments based on buildings in progress, as well as those already completed. The resulting digital solutions, VNG and VS, are now at the forefront of the visual assessment of proposed major developments across the North East of England.

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

R1. Greenwood, D.*, **Margaret Horne**, **Emine M**. **Thompson**, Allwood, C.M., Wernemyr, C., and Westerdahl, B. **(2008)** 'Strategic Perspectives on the Use of Virtual Reality within the Building Industries of Four Countries', *International Journal of Architectural Engineering and Design Management*, **4**, 85-98. DOI:10.3763/aedm.2008.0076

R2. **Emine M**. **Thompson** and **Margaret Horne** (**2009**) 'Sharing 3D City Models' in: *Computation: The New Realm of Architectural Design* (27th eCAADe Conference Proceedings) 261-267. ISBN 978-0-9541183-8-9. Available on request

R3. **Margaret Horne**, **Emine M**. **Thompson**, and **James Charlton** 'Towards a Multifunctional Virtual City Model', in N.N. Pinto, J.A., Tenedorio, A.P., and Antunes, J. Roca (eds) *Urban and Spatial Planning: Virtual Cities and Territories*, (IGI Global, **2012**) DOI:10.4018/978-1-4666-4349-9.ch008

R4. James Charlton, **Bob Giddings**, **Emine M**. **Thompson**, and Peverett, I. (**2015**) 'Understanding the interoperability of virtual city models in assessing the performance of city centre squares' *Environment and Planning A*, **47**: 1298 DOI:10.1177/0308518X15594904

R5. Emine M. **Thompson**, **Paul Greenhalgh**, **Kevin Muldoon-Smith**, **James Charlton**, and Dolnik, M. (**2016**), 'Planners in the Future City: Using City Information Modelling to Support Planners as Market Actors', *Urban Planning* **1**:79-94 DOI:10.17645/up.v1i1.556

*Internal Collaborator: Greenwood, D., Dept. of Mechanical and Structural Engineering (UoA12)

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

New visualisation techniques developed by researchers from Northumbria – Virtual NewcastleGateshead (VNG) and Virtual Sunderland (VS) – have provided local authorities and architectural practitioners throughout the North East of England with a more accurate understanding of the visual impact that proposed developments will have on sensitive cityscapes. These tools now feature as embedded elements within new planning policies for Gateshead Council (GC), as well as Newcastle (NCC) and Sunderland (SCC) City Councils. They have informed strategic development plans undertaken by each Council, and provided a more effective process for pitching, assessing, and marketing key development proposals.

4.1 Improving the effectiveness of assessment processes for major planning proposals and heritage preservation
Since 2014, the novel visualisation techniques and virtual tools developed through collaboration with Northumbria have been used in the assessment of 20 major developments [**E1**], totalling over GBP1,300,000,000 worth of investment, primarily in Newcastle [**E2a**]. In this period, the model was used by NCC and GC to inform the approval process for a series of major proposals, including the West Quay in Newcastle (GBP250,000,000) and the Gateshead Quayside Arena (GBP260,000,000) [**E1**, **E2a**]. It has also informed the proposed development of Europe's biggest Ferris wheel, dubbed the 'Whey Aye' (140m high/112m diameter, to be located on the former Spillers Quay in Newcastle) [**E3**]. NCC's July 2019 planning committee report highlighted the integral role the VNG has played in the decision-making process, allowing them to understand the impact across the cityscape [**E4**, p32, p35].

In Sunderland, Northumbria research has been incorporated into the Riverside Sunderland Supplementary Planning Report, published in June 2020 [**E5**; **E6a**, p76]. The VS tool was singled out as a best-practice model for the assessment of planning proposals on this major re-development scheme. The project will double the resident population of the city centre to over 5,000, increase employment by 50% to 18,000, and attract significant investment, such as financial services giant Legal & General, which announced in 2019 that it would invest GBP100,000,000 into site [**E6b**]. As the planning report itself noted, the VS tool *'provides clients with 3D city data of their site and surrounding context to support their own internal assessment and design development, and access to the larger virtual city model via physical or virtual workshops to support the assessment of the proposal and the generation and capture of desired views'* [**E6a**, p76].

The influence of these new digital tools has followed operational advantages. Richard Charge, Urban Designer, NCC, noted *'VNG provides valuable and tailored assessments that are not possible through traditional processes. Option testing and enhanced data layering at a citywide level are some of the most useful features and the biggest shift from traditional methods. This is particularly useful when looking at strategic views of the city and understanding the likely impact*

on the surrounding built environment' [**E2a**]. This resulted in NCC issuing a protocol for the use of VNG in the planning process [**E2b**].

For Gateshead Council, Ian Burchell, Urban Design Officer, stated that since 2014, research by Charlton and the team from Northumbria provided *'entirely new visualisation techniques* [which have] *… allowed the council to test out various design scenarios to help inform design guidance and policy making'* [**E7**]. The planning process has become *'more efficient by simplifying previously time-consuming aspects'* [**E7**]*.* The results are *'more cost effective, time efficient and accurate* [assessment procedures]' [**E7**].

Similar benefits have been noted by SCC, with the Regeneration Manager for the council confirming how the VS tool, now plays a *'pivotal role … and has informed the way in which development and regeneration proposals work within the wider geography of the city'* [**E5**]. It has provided the council with the capacity to *'visualise and assess our masterplans and regeneration proposals in a way that has previously not been possible'* [**E5**]. The council has confirmed how the research *'has changed both the way we work and the way we market the city* … [the VS tool] *is not only a powerful assessment tool guiding current and future development of sites, but also a powerful marketing tool used to demonstrate to inward investors the development opportunities that exist in the city'* [**E5**].

VNG has also played an important role in heritage preservation [**E3**]. As noted by Simon Parkin, NCC's Historic Environment Officer: *'VNG has allowed for a far more comprehensive understanding of potential impacts of a proposed development on the settings of, and views to and from, heritage assets.'* He noted the complexity of assessing settings, and the risk this carries for the historic environment [**E3**]. Stakeholder engagement is also made easier with the tool, and Parkin has observed how the research has ultimately facilitated *'a more open discussion* [with] *… key external stakeholders, such as Historic England'* [**E3**].

4.2 Informing strategic planning for urban development and investment
As well as improving efficiency of the fundamental assessment process, Northumbria's research has also played a central role in shaping long-term strategic planning through development of supplementary planning documentation. The research helped to shape the development of NCCs Landmarks and Gateways Strategy: *'this planning guidance is a long-term strategic priority for the region that will play a significant role in shaping the development of the city-space and environment'* [**E2a**]. This strategy *'relied upon the enhanced planning and visualisation tools provided by Northumbria research. The finalisation and agreement of this strategy would not be possible without the insights offered by the VNG digital tool'* [**E2a**]. The conservation team at NCC have confirmed how the research insights have also contributed to the development of a new Tall Buildings Strategy which *'has relied upon the enhanced planning and visualisation tools provided by Northumbria research'* [**E3**].

The council has also outlined how, as a result of Charlton's contribution to its Envisioning Futures report [**E8**], the VNG is now *'directly shaping a key element of a broader national strategy for urban planning'* [**E2a**]. The Newcastle City Futures 2065 project, funded by the Foresight Programme of the Government Office for Science under the direction of the Chief Scientific Adviser to HM Government, adopted Newcastle upon Tyne as a pilot area. Foresight projects are funded by government to give evidence to policymakers to help them create policies that are more resilient to the future. This was the first time that a Foresight project was commissioned for a regional project rather than commencing with a national project first. The VNG tool has become a central component of this pilot scheme, in turn shaping a national strategy that will determine *'city-wide participatory processes in urban design across the UK for the next 50 years'* [**E2a**].

4.3 Providing a more accessible planning process to support external stakeholders
The ongoing developments to the tools developed by Northumbria have made planning processes more accessible and transparent for the external stakeholders involved, including planning practitioners, heritage organisations, and community groups [**E2a**]. NCC reported how

the research *'has been especially important by enabling constructive engagement with stakeholders at a much earlier stage during pre-application … creating a new opportunity for interventions earlier in the design process'* [**E2a**]. In particular, the research has helped practitioners, including planning officers, planning consultants, architects, and developers to improve their engagement with local authority planning departments by getting a more comprehensive understanding of their proposal earlier on in the process [**E2a**]. Findings from a survey carried out by NCC provided an indication of the range of positive response from those who have engaged with VNG through the planning process, with 94% finding it useful, 57% reporting time savings, and 27% noting that it provided cost reductions [**E2a**, p3-5].

Ronnie Graham is Director of Ryder Architecture, an award-winning international design practice with 180 staff located in offices around the world. He has reiterated the benefits that organisations such as his own have seen from engaging with Northumbria's work, reporting that the use of the VNG has changed the way they undertake pre-assessment of proposals. He stated that *'VNG allows us to work much closer with the council to identify views that specifically need detailed and further assessment, providing a much more informed and efficient process and allowing to have more valuable discussions at an earlier stage, to understand the likelihood of getting planning permission'* [**E9**]. Graham noted how this provides efficiencies that saved both time and money and ultimately has *'undoubtedly resulted in better urban design'* [**E9**].

The underpinning research has resulted in a transformative approach to urban planning, enhanced by experiences that are both information-rich and interactive. This body of work has improved the transparency, accuracy, speed, and volume of the city-scale assessments and ultimately helped to protect the development, urban quality, and resilience of these sensitive cityscapes.

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

Ref.	Source of corroboration	Link to claimed impact
E1	List of developments/projects research has supported since August 2013	Corroborates range and scale of projects using VCM tool and research insights
E2	a) Testimonial and Practitioner Feedback - Urban Designer, Newcastle City Council b) VNG Interim protocol, Newcastle City Council	Confirms how research informed development of new planning process, strategic plans (NCCC), and work of external practitioners/stakeholders
E3	Testimonial - Heritage officer, Newcastle City Council	Confirms how research informed development of new planning process, strategic plans (NCCC), and work of external practitioners/stakeholders
E4	Planning committee report, 'Whey Aye Wheel' (2018/1639/01/DET)	Confirms how research informed planning decision for 'Whey Aye' wheel
E5	Testimonial - Regeneration Manager, Sunderland City Council	Demonstrates how research informed creation of a new planning process
E6	a) Riverside Sunderland Supplementary Planning Report - Sunderland City Council b) News Coverage - Sunderland Echo	Demonstrates how research informed development of new strategic plans (Riverside Development Scheme)
E7	Testimonial - Urban Design Officer, Gateshead Council	Confirms how research informed new planning process and work of external practitioners/stakeholders
E8	'Envisioning Futures', Newcastle City Futures 2065 Report (Funded by Government Office for Science)	Demonstrates the central role that research played in developing the Newcastle City Futures 2065 strategy
E9	Testimonial - Director, Ryder Architecture	Confirms how research improved effectiveness of planners/developers