Institution: University of Leeds

Unit of Assessment: C-17

Title of case study: Case 3 - Retail network research influences location decision-making and improves effectiveness for major global retailers and public service organizations.

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

Spatial models developed from research in the School of Geography about population movements in cities are informing commercial planning and public policy analysis. The conduit for this impact is GMAP Ltd., a spin-out company established by the University of Leeds, which has used the models as the basis for its MicroVision and RetailVision software. Companies including Ford, Exxon, HBoS and Asda-Walmart have used this software for a range of purposes including maximizing individual stores' profitability and reconfiguring entire networks to fit changing market conditions. Government agencies have also used the software to optimize resource allocation in policing, education and healthcare.

2. Underpinning research

The School of Geography (SoG) at Leeds has a strong tradition in modelling population movements around cities and regions. Spatial interaction models of the flow of customers from residential neighbourhoods to retail outlets were developed by Alan Wilson (Professor of Urban and Regional Geography at Leeds 1970-2004; now at University College London). During the 1990s, key parts of this research were conducted in partnership with Professor **Martin Clarke (**SoG Professor of Geographic Modelling since 1994)**,** Professor **Mark Birkin** (joined Leeds 1989 as lecturer; Professor since 2009) and Professor **Graham Clarke** (appointed as Lecturer in 1989; Professor since 2004). Other Leeds contributions include Daniel Vickers (doctoral student and ESRC Fellow at Leeds 2000-2006; now at Sheffield) and Professor **Philip Rees** (Emeritus Professor since 2012) who supervised Vickers' doctoral research). Three fundamental extensions of the SoG's work on the optimal configuration of retail networks have contributed directly to the enhancement of location decision-making and business effectiveness for corporations and public service organizations. These extensions are: a) network optimization algorithms; b) analysis of long-term retail market trends; and c) geodemographic classifications of population and consumer behaviour.

In 1995, **Birkin** and **M. Clarke** published a sophisticated algorithm for network optimization in response to complex customer choices **[1]**. This work provided a platform for Idealized Representation Planning of retail networks **[2]**. These papers arose specifically from EPSRC research (GR/J99278/01, 1994-95, PI N. Radcliffe, £35,790) involving collaborations with mathematicians and computer scientists at the Universities of Edinburgh (Nick Radcliffe, Felicity George, Mark Smith) and Leeds (Peter Dew). Developments of this technique were able to provide a robust methodology for evaluating network mergers and their subsequent reorientation or rationalization **[3]**. This approach was further developed through pre-2008 involvement with users including Ford Motor Corporation in Great Britain, Europe and North America, which employed an Idealised Representation Planning capability in reforming dealership networks, and Halifax PLC, which developed a national plan for integration of the branches of the Leeds Permanent and Halifax Building Societies after demutualization in 1997.

The analysis of long-term retail trends and the interactions between network development and planning policy have posed higher level and more strategic questions about the impact of corporate policies and government planning regimes on the retail environment. This work, led by **G. Clarke** in association with Cliff Guy (University of Wales) and Neil Wrigley (Southampton), has brought two important insights: First, the idea that prolonged network expansion by the major retail chains has led to some degree of market saturation has been debunked; second, in particular areas a lack of provision is evident to the extent that extensive food deserts still exist in many areas [for example, **4**].

Further contributions to the understanding of customer/service user networks have been made

through the development of geodemographic classifications of population and consumer behaviour. Working with the Office for National Statistics, researchers at Leeds developed an Output Area Classification (OAC) which is capable of appraising customer behaviour according to the demographic characteristics of residential neighbourhoods, as well as other potential applications for service providers **[5]**. An indicative pre-2008 application here is the use of OAC by South Yorkshire Police to profile the victims of crime and anti-social behaviour to inform neighbourhood profiling strategies (http://areaclassification.org.uk/2000/01/01/oac-used-by-south-yorkshire-police/).

3. References to the research (indicative maximum of five references)
The results of this research have been published in a range of international peer-reviewed journals. Outputs 3 and 4 were included in Leeds' RAE2008 submission (95% of research 2* or better) and Output 5 was submitted by Sheffield (95% of research 2* or better).

Three representative articles advancing understanding of retail network optimization

1. Birkin M., **Clarke M.** and George F (1995) The use of parallel computers to solve non-linear spatial optimisation problems: an application to network planning, *Environment and Planning A, 27,* 1049-1068. doi:10.1068/a271049

2. George F, Radcliffe N, Smith M, **Birkin M.** and **Clarke M.** (1997) Algorithms for solving a spatial optimisation problem on a parallel computer. *Concurrency: Practice and Experience*, 9(8), 753-780. doi:10.1002/(SICI)1096-9128(199708)9:8<753::AID-CPE246>3.0.CO;2-Q

3. Birkin M., **Clarke G.** and Douglas L (2002). Optimising spatial mergers: commercial and regulatory perspectives. *Progress In Planning.* 58(4) 229-318. doi: 10.1016/S0305-9006(02)00039-9

A representative article on the analysis of retail market trends and the interactions between network development and planning policy

4. Clarke G.P., Eyre H and Guy C (2002) Deriving indicators of access to food retail provision in British cities: studies of Leeds, Bradford and Cardiff, *Urban Studies*, 39(11), 2041-2060. doi: 10.1080/0042098022000011353

Output describing the creation of the National Statistics 2001 Output Area Classification

5. Vickers, D. and **Rees, P.H.** (2007). Creating the National Statistics 2001 Output Area Classification. *Journal of the Royal Statistical Society, Series A* 170(2), 379-403. doi:10.1111/j.1467-985X.2007.00466.x.

4. Details of the impact
Overview of impacts

The methods and techniques reported here have been deployed widely amongst retail and service organisations in diverse sectors including high street retailing, financial services, petrol distribution, the automotive industry, groceries and recreation. This has had a significant economic and social impact by facilitating business expansion and the development of more efficient, profitable, sustainable and consumer-friendly retail and service networks. Many employment opportunities have also been created for geographers to provide consultancy and planning software to retail organisations. For example, GMAP alone has recruited more than 30 employees from the School of Geography, including more than a dozen graduates since 2008.

The impacts of this research are substantial and have accumulated over a considerable period of time. Initially, the products of the research were commercialised through a University spin-out business, GMAP Ltd. (1990, sold by the University to a private firm in 1997). The company was used to provide executable software algorithms to assist companies in the preparation of network

plans and strategies. These software algorithms have now evolved into two product suites that are employed by GMAP in advising and providing analytical consultancy services to a global portfolio of clients on five continents about the geographical dimensions of their channels to market. Academics from the School of Geography have also continued to provide advice and models independently to both corporate and public sector clients.

Use of the models by GMAP to advise an international portfolio of retailers

Since 2008, GMAP, part of Callcredit Information Group PLC, has embedded the consumer modelling techniques developed in the School into two key product suites - Microvision (2010) and Retailvision (2011) - that it uses with a variety of clients around the world. Annual turnover of each product suite is around [text removed for publication]. Dissemination and impact has been facilitated through GMAP, with which the School has maintained close ties. The GMAP products are capable of examining a range of issues related to retail channels strategy with diverse impacts ranging from property management and financial planning to marketing and promotion, logistics and merchandising. They work by bringing together a variety of data about consumers, retailers, accessibility, brands and so on to populate the spatial models described above. These models are then deployed to address a range of tactical and strategic issues relating to the geographical aspects of the retailer's channels to market **[A]**. Examples include:

(i) Adidas has been using Microvision since 2008 to develop a presence and branded store concept in the Asia Pacific region. This includes work in Japan, South Korea, Indonesia, Australia, Taiwan, Thailand, Singapore, India and Vietnam and the development of a physical network plan for the Chinese market, studying 45 cities.
(ii) Volkswagen Group (since 2010): using Microvision to plan an integrated dealer network strategy for its four brands - VW, Audi, Seat and Skoda - across Europe and most recently India. This has enabled Volkswagen Group to align the dealer networks and provides specific recommendations for dealer openings/relocations/closures to achieve future sales targets. These plans are developed in collaboration with local National Sales Companies and Importers and once signed off provide the blueprint for dealer network change and are monitored by Volkswagen Group.
(iii) ExxonMobil (EM): GMAP is the longstanding global supplier of retail forecourt network planning for Exxon-Mobil (since 2001). Systems have been provided to EM in many strategic markets across Europe, in Canada, in Asia-Pacific, including Japan, Malaysia and Singapore as well as in South and Central America, including Brazil. Microvision enables EM to plan the full forecourt offer including fuel, convenience stores, quick-service restaurants and car wash.
(iv) Other clients using Microvision include Greggs, Ladbrokes, Clarks, John Lewis, Camelot and Mothercare.

The Japanese subsidiary of GMAP has developed its own version of Microvision which uses the Leeds modelling tools to assist a range of clients including EMG Marketing, Adidas, Rockport, and L'Oreal **[B]**.

Impacts on corporate retail networks

Birkin and M. Clarke have used their analytical techniques directly with a number of clients, including Thomas Cook (2008) **[C]**, and the Post Office (2010-2012). Activities for the Post Office have improved decision-making and enhanced access to products in a network which serves more than 20 million customers every week, and reduced costs in a network with an annual government subsidy of £150M. The methods allow new products to be targeted at locations with the greatest potential; financial management of outlet performance for different types of outlets and locations; and network differentiation to meet guidelines for minimum requirements for spatial accessibility. Specific outputs include a network segmentation which was last updated in January 2012, with further applications to an assessment of small area demand for various financial products (January 2010) and an evaluation of competitive performance in the sale of foreign currency (July 2009) **[D] [E]**.

Impacts for public service providers

The OAC codes **[F]** are now attached to the ONS annual survey of Family Spending (since November 2008) and to the British Population Survey (since June 2010) **[G]**. The users of OAC in studies of the provision of services include Worcestershire County Council **[H]**, Yorkshire and Humberside Public Health Observatory **[I]**, and Local Futures (a research and strategy consultancy that provides a geographical perspective on economic, social and environmental change) **[J]**. This demonstrates that the OAC is freely available to users and is promoted by the ONS. The founder and director of Local Futures asserts specifically that OAC provides service providers and local governments with opportunities 'to better understand your citizens, customers and communities' **[J]**.

5. Sources to corroborate the impact

[A] Letter from Commercial Director, GMAP Consulting; dated 3 September 2013. Corroborates the narrative on development of SoG model products from computer software into the RetailVision and MicroVision products; and the impact narrative regarding the application of these products in major corporations such as Adidas, Volkswagen Group, ExxonMobil. [Available on request]

[B] Letter from Representative Director GMAP Japan: Corroboration of the impacts in the Japanese market; dated 27 September 2013. [Available on request]

[C] Report and software prepared for Thomas Cook, July 2008. [Available on request]

[D] Email from former Head of Network and Location Planning, the Post Office
Corroboration of the role of spatial analysis and models from SoG in Post Office network reconfiguration exercise; dated 20 June 2013. [Available on request]

[E] Network Segmentation Refresh report for the Post Office, dated January 2012. [Available on request]

[F] Office for National Statistics Area Classification for Output Areas:
http://www.ons.gov.uk/ons/guide-method/geography/products/area-classifications/ns-area-classifications/index/index.html [Last accessed 18/10/13]

[G] British Population Survey (www.thebps.co.uk), ONS Family Spending Survey (available at www.statistics.gov.uk/statbase). Website at: http://www.ons.gov.uk/ons/rel/family-spending/family-spending/family-spending-2011-edition/index.html [Last accessed 18/10/13]

Website at http://www.ons.gov.uk/ons/rel/family-spending/family-spending/2008-edition/index.html (introduced into Family Spending in the 2008 edition, released November 2008) [Last accessed 18/10/13]

[H] Research Manager, Worcestershire County Council
(http://www.slideshare.net/alexsingleton/using-geodemographic-classifications-for-customer-insight), dated 3 September 2010. [Available on request]

[I] Public Health Information Analyst, Yorkshire and Humber Public Health Observatory; http://areaclassification.org.uk/files/2010/01/simon-orange-oac-15-sept-2008-slides-view.pdf, dated 15 September 2008. [Available on request]

[J] OAC User Group (http://areaclassification.org.uk/)
This demonstrates that an independent group has arisen using the OAC for commercial and public sector applications. Used in documents from the OAC User Group Annual Conference 2010: http://areaclassification.org.uk/2010/09/07/place-based-budgeting-making-efficiency-saving-with-oac-in-an-age-of-austerity/, dated 6 September 2010 [Available on request]