Cardiff School of Planning and Geography

The Organisation and Practices of Mapping Rural Statistics:

A Case Study of Wales

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Abstract

Working at the Wales Rural Observatory (2004 - 2014) provided first-hand experience of mapping rural statistics for policymaking. It was evident that representing social and economic data in population-sparse areas was not as straightforward as the technology permitted. Mapping could reveal rural issues but also caused others to be hidden or misrepresented. This was an issue worthy of further investigation. How was this understood by others attempting to represent social and economic statistics? Were mistakes made, could they be rectified, and what were the consequences?

Literature linked to the topic was fragmented; split between the technical, theoretical and practical. This research has attempted a synthesis, helping develop concepts to guide this research and a lens for understanding mapping practices within organisations.

A case study of Wales was used to investigate mapping practices used for policymaking and planning, applying qualitative methods to study quantitative practices. Studying mapping required more than technical knowledge and more than just critique, it required the study of mapping in context, and more so the detail of these processes in action. As such this research focussed on the experiences of those closest to these processes in an attempt to sensitise future studies to often overlooked interactions.

Multiple barriers existed in Wales and included a lack of technical awareness, capacity, and appropriate training. To overcome these barriers the literature suggests that mapping practices become collaborative activities. However this should not be just in the formation or presentation stages but throughout the mapping process. As a collective all resources can be pooled and used many times, with common rules defined through a process of debate and learning, with all forms of knowing admissible. The technology is certainly in place to enable this to happen. The challenge going forward is raising awareness and creating frameworks that enable this to happen.

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List of Acronyms and Abbreviations

2.5D - Two and a half dimensions

ADRN - Administrative Data Research Network

AGI - Association of Geographic Information

ALF - Anonymous Linking Fields

ANT - Actor Network Theory

APS - Annual Population Survey

BCS - British Computer Society

CAP - Common Agricultural Policy

CCW - Countryside Council for Wales

CGeog - Chartered Geographer

CGI - Centre for Geographic Information

CHEST - Combined Higher Educational Software Team

CPD - Continuing professional development

DaaS - Data as a Service

DCLG - Department for Communities and Local Government

DH - Department for Health

DIME - Dual Independent Map Encoding

DNF - Digital National Framework

DU - Data Unit

DWP - Department for Work and Pensions

E-government - Electronic government

EDA - Exploratory Data Analysis

ESDA - Exploratory spatial Data Analysis

ESRC - Economic and Social Research Council

ESRI - Environmental Systems Research Institute

EU – European Union

EUROGI - European Umbrella Organization for Geographic

GI – Geographical Information

GIS – Geographical Information Systems

GISRUK - GIS Research UK

GPS- Global Positioning System

GSS - Government Statistical Service

GUI - Graphical User Interface

GVA - Gross Value Added

HCI - Human Computer Interaction

HMLR – Her Majesty's Land Registry

HTML5 - HyperText Markup Language version 5

ICO -Information Commissioner's Office

ICT - Information Communication Technology

INSPIRE - Infrastructure for Spatial Information in the European Community

IPF - Iterative Proportional Fitting

JSA - Job Seekers Allowance

LA - Local Authority

LAN - Local Area Networks

LDP - Local Development Plan

LGA - Local Government Association

LGMB - Local Government Management Board

LLLW - Lifelong Learning Wales

LSB - Local Service Board

LSBi - Local Service Board Insight

LSOA - Lower Super Output Area

MAUP - Modifiable Areal Unit Problem

MEP - Member of European Parliament

MIMO - Map In - Map Out

MP - Member of Parliament

MSOA - Middle Super Output Area

NAfW- National Assembly for Wales

NERC -Natural Environment Research Council

NGDF - National Geospatial Data Framework

NGO - Non-Government Organisations

NHS - National Health Service

NISCHR - National Institute of Social Care and Health Research

NOMIS – National On-Line Manpower Information System

OA - Output Area

OCSI - Oxford Consultants for Social Inclusion

OGC - Open GIS Consortium

ONS - Office for National Statistics

OS - Ordnance Survey

PaaS - Platform as a Service

PDA - Personal Digital Assistants

PSMA - Public Sector Mapping Agreement

QGIS - Quantum GIS

RALF - Residential Anonymous Linking Fields

RDP - Rural Development Plan

RGS - IBG - Royal Geographical Society - Institute of British Geographers

RICS - Royal Institution of Chartered Surveyors

RLP - Regional Learning Partnership

RLPSWW - Regional Learning Partnership South West Wales

RLSO - Regional Learning and Skills Observatory

RRLs - Regional Research Laboratories

RSS - Rich Site Summary

RTPI - Royal Town Planning Institute

SaaS - Sofware as a Service

SAE - Small Area Estimation

SAIL - Secure Anonymised Information Linkage

SLA - Service Level Agreement

SOA - Super Output Area

SSSI - Site of Special Scientific Interest

SWAMWAC - South West and Mid Wales Consortium

TII - Tradable Information Initiative

UDP - Unitary Development Plan

UK - United Kingdom

UKSGB - United Kingdom Standard Geographic Address Base

UPRN - Unique Property Reference Number

US - United States

USA - United States of America

USOA - Upper Super Output Area

ViSC - Visulaization in Scientific Computing

VML – Virtual Microdata Laboratory

WA - Welsh Assembly

WEFO - Welsh European Funding Office

WG - Welsh Government

WGSB - Welsh Government Sponsored Bodies

WIMD - Welsh Index of Multiple Deprivation

WISERD - Wales Institute of Social and Economic Research, Data & Methods

WLGA - Welsh Local Government Association

WLGA - Welsh Local Government Association

WO - Welsh Office

WRO - Wales Rural Observatory

WWW - World Wide Web

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This thesis has been produced for the degree of Doctor of Philosophy at Cardiff University, School of Planning and Geography. It investigates a wealth of cartographic literature as well as the emerging field of geographic visualization. It builds links between the social and physical sciences in an attempt to fixing a qualitative lens upon a largely quantitative practice that has been adopted by organisations in Wales and elsewhere. The focus of this study is the mapping of rural statistics in core policymaking organisations. To be clear rural statistics are population-based statistics about rural areas.

Central to this thesis is the aim to improve the links between both social and economic statistics and policy makers when deliberating rural areas, enabling the efficient dissemination of this information, in practice, for policy making. The idea for the thesis was conceived while working as a GIS research associate for the Wales Rural Observatory (WRO) at Cardiff University.

The WRO was a small research centre that conducted independent research on social and economic issues in rural Wales. The Observatory consisted of a group of researchers operating from Cardiff University and Aberystwyth University. The work of the WRO commenced in September 2003 and ended in early 2014.

The Observatory's activities focussed on two main areas: firstly, the collection and analysis of rural data, and the presentation of these data within a Geographical Information System (GIS); secondly, undertaking mixed methods research on social and economic issues in rural Wales. The Observatory focussed its activities around the following five broad themes: Rural Economy and Employment; Environment, Sustainability and Land-use Planning; Social Inclusion and Exclusion; Housing and Service Provision; Society and Community (WRO, 2004).

As a GIS research associate, there was a requirement to bring together and visually represent rural statistics – commonly in the form of a thematic map. In addition, this involved the incorporation of statistics and graphics in a series of research reports. It became evident that a substantial portion of the effort required to produce a map output took place before the information was presented to a wider audience. In essence, to anyone who was not involved in the early stages of map production,

much would remain unknown and hidden. This could be considered analogous to a black box scenario in science and engineering, in the sense that much of the internal activity and discussion would not emerge explicitly in the output.

Mapping rural statistics required learning and understanding many new skills as well as developing an understanding of the population distribution in Wales and its characteristics. However this was an ongoing process of learning as organisations, technology and people changed. What was learned became forged within any visual representation during the 'hidden' production and exploration processes. Regardless it became apparent there was potential for resulting representations of rural Wales to be exposed to misinterpretation. Mapping was a process that was part exploration and part communication.

Mapping, to some extent, revealed how the countryside was differentiated but in doing so, had the potential to mask certain issues. In some situations, it was possible to overemphasise a rural social and economic problem within the map but too often mapping also caused rural issues to become hidden. Mapping alone was not enough to tackle rural issues. Moreover, the ways in which mapping could applied within certain contexts were worthy of further study. It became apparent that there were limited formal feedback mechanisms to judge how these visual representations of rural statistics were being used to make decisions. It was hence realised that mapping processes within and for policy making were relatively poorly understood. A better understanding of the hidden processes of mapping rural statistics could reflexively improve future decision-making processes. In addition, it would ensure that people in rural a Wales are not being put at a disadvantage just because of the uptake of geospatial technology within policy making.

Chapter 1 – Introduction

1.1 Introduction to the subject matter of this thesis

This chapter will introduce the subject matter of the thesis and describe the key concepts that reoccur throughout. This thesis seeks to further explore the concept of scientific visualization and understand its application to rural statistics for policy making.

This thesis discusses rural statistics throughout. As a concept rural statistics refer to population related datasets that that are collected from population sparse areas. In other words, rural statistics are population statistics about rural areas. As such there is nothing inherently rural about the statistics themselves as they could be collected throughout Wales. In this thesis attention is directed to where these statistics are used to substitute, and represent, people working and living in rural Wales. It is argued that during mapping the representation of these data becomes problematic using area based mapping techniques. So to clarify, throughout this thesis rural statistics will be used to refer to population data gathered about rural Wales.

Scientific visualization is a rather vague term but basically refers to the application of computers to transform abstract data into concrete representations for cognition (McCormick et al. 1987b). Scientific visualization is reported to 'offer a method for seeing the unseen'. It enables information hidden within large datasets to be extracted to provide knowledge. "The scientific visualization of social structure means, literally, trying to make visible the geographical patterns to the way our lives are socially organised, seeing the geography in society" (Dorling 2012).

In the case of this thesis, the focus is how scientific visualization has been applied to social and economic statistics. Statistics associated with quantification of people living and working in rural Wales. Rural statistics have multiple dimensions but are linked by the common notion of geographic location when represented in maps. Throughout history, maps have been the standard mechanism for representing geographic problems. Mapping is also about making space visible and comprehensible. This practice has gained renewed strength with the rise of digital mapping and GIScience in recent years.

Technological developments have, to some extent, changed the way maps are used. This is despite there being a lack of theory of the application of maps to policy problems. Despite lacking theoretical alignment, mapping has increasingly become used in policy making at multiple levels of government and governance. Maps, to some extent, have a legacy as a part of governing (Faludi 1973) but recently, due to the uptake in geospatial technology within government and planning organisations, have become a tool for policy making. Mapping has an important role to play in organising spatial issues and increasingly at a localised level and where multiple interests need to be considered. Maps can be used to direct the gaze in order to achieve balanced economic, environmental, and social growth ('win' 'win' 'win' situations) but maps have also been known to lie.

According to Geertman (2002), the fields of spatial planning, geographical information systems (GIS) and communication technology (ICT) were developing at their own pace and in different directions. Regardless, the map as a representational metaphor and a main display mode is now key to a whole raft of new interactive visualizations of scientific data (Dodge, 2014). It is here where the fields of scientific visualization and cartography have been brought together to powerfully classify, represent and communicate information about spaces that are too large or too complex to be directly observed. The study of where these elements combine has been termed geovisualization (Dykes, et al., 2005). Geovisualization is a tool that can be applied to highlight social structures locked in large datasets (Dorling, 1991) and provide 'a new way to think spatially' (MacEachren, 1995, p. 460) through interactive exploration and graphic ideation. This contrasts with the more passive study of paper maps, which are fixed and are used to confirm what is already known and confirm a predetermined hypothesis. Hence, maps can function both as a practical tool for information processing and as a compelling form of rhetorical communication.

This thesis, therefore, focuses on a specific type of scientific visualization related to geography. All these processes can be referred to as the practice of mapping. Mapping then is a way to thinking about the world, a means to make territory and a mechanism to visibly plot places in to existence (Dodge, 2014). Commerce, government and all manner of daily communications are now often transacted through some form of visual media and regularly this is via some form of digital and networked device. Mapping may be but a small fraction of this visual media, but is powerful because of the map's ability to represent a vision of reality in a believable way and in doing so retain meaning to transfer it to others (Faludi 1973, p. 72). This

enables maps to be understood as 'immutable mobiles', according to Latour (1987). This means that maps can work to change aspects of the world they only perhaps superficially represent. Hence, lays the subject matter of this thesis.

1.2 The Study of Mapping in Policy Making Processes

Policies are 'aims or goals, or statements of what ought to happen' (Blakemore and Griggs, 2007, 1). The thesis takes a broad view on policy making as the process by which governments in conjunction with LAs provide the architecture to translate their political visions into programmes and actions to deliver 'outcomes' - change in the real world. Thus, policy making can be considered a fundamental function of government. Consequently, the policy process is a site in which aspirations emerge, are debated and given representation. Investigating the use of maps in these processes enables an understanding on how public interests are conceived, what these are deemed to be, and why some interests are given priority over others.

To understand mapping in practice requires an investigation into a specific aspect of the policy making process. According to Hill (2009), studies of the policy making process can broadly be distinguished according to whether they are studies of policy or studies for policy. Although Hill (2009) does acknowledge that the two types of study are often interlinked.

Studies of policy may include investigations into how policy decisions are made and shaped in action; whereas, studies for policy tend to involve the collection of data in order for policy makers to reach decisions or to evaluate the impact of policies.

This research falls into the category of a study of policy in so much as it follows those that undertake studies for policy. It asks the questions: How do policy practitioners construct evidence for policy purposes, using mapping, and what role does this play in terms of how policy decisions are made? However, by asking these questions and collecting empirical evidence, this research may provide information that could be used for policy. Research and policy processes are very much intertwined.

According to Hill (2009), much of policy making takes place within institutions¹. This therefore seems a reasonable starting point for a case study routed in policy-making processes. Despite commonly being housed within institutions, policy making often takes place as a unique sequence of events (Hill, 2009) and is hence difficult to study in a formulaic fashion. Although this investigation explores elements of the process of policy making, there is no need to also assume that this process is rational and takes place in clearly distinct stages (Hill, 2009). For the purpose of description, stages will be used to describe critical junctures that emerge from within a complex mosaic of actions. This is why an actor-orientated approach is preferential as it enables factors that cause differentiation to be explored in greater detail. However, this does have the consequence of there being little scope to compare with previous work.

A flexible, theoretical approach to the investigation of part of a policy making process is useful then as it enables research to unfold in an explorative manner rather than adhering to restrictive preconceptions. According to Hill (2009), policy process studies are very often case studies using qualitative methods. Using a case study approach therefore provides suitable grounding in academic rigour whilst permitting scope to be reactive to unforeseen events. The conceptual guidance within the case study revolves around human and non-human (e.g. GUI, maps, etc.) elements, all organised and bound together in a common relational manner: the policy process.

Using this type of flexible qualitative focussed design is useful for an investigation into the policy process as there are many relevant activities in the process that are very hard to observe. Explorative mapping processes would be one of these activities (despite the output, the map, often becoming public). According to Hill (2009), many power processes are necessarily covert and involve restricted environments or data. Therefore, what emerges to the public is often only the tip of the iceberg. Much takes place behind closed doors, often without justification for doing so aside from convenience. In Wales attempts have been made to remove this veil, for example, the use of media to broadcast Welsh Assembly debates. However, it still remains that much of the work in the policy process is still conducted by the civil service and does not make its way into our daily lives. It is therefore here, in

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¹ Institutions can be an organisation or established aspects of wider society, which embody common values or ways of behaving. An example of the former is the UK National Health Service and the latter the institution of marriage (Thomas, 2010).

these private realms, where attention will be focussed. It is here where those at the human computer interface and those around them can be observed. Although we often get to see the 'eye candy' that is the final communicative map in a policy report; this emergent map often masks the majority of the more interesting decisions and events that took place and to facilitate its creation.

The policy process seems to be complex as it involves multiple people and multiple decisions at multiple times culminating in a form of common, often contested, understanding of policy. Rather than attempt to unravel policy making in its entirety, this research concentrates on the interfaces where mapping practices become intertwined. In addition, it is worth remembering that policy does not take place in a vacuum, it is contingent on what has taken place in the past and what other policies are currently active. According to Hill (2009), policy can change over time, in that as society changes so too can a policy; this can also be a result of past experiences fed back in to the policy process. Therefore there are feedback loops that effect policy processes. How this type of feedback relates to mapping practices and the extent to which it can affect policy remains little understood, especially in terms of map use and social and economic statistics.

1.3 Rural Social and Economic Statistics

There are many ways of knowing the 'rural'. This makes the concept of rural Wales difficult to define. As such, there is no single definition of rural Wales (WRO, 2004). The different definitions in different contexts are somewhat reflective of the multiple issues rural Wales faces and the segmentation of rural policy between different departments. For detailed accounts of rural Wales, see Milbourne (2011), Cloke et al. (2006), and Marsden (2003).

Moreover, rural statistics can be considered one of several forms of evidence that can be used for policy making. Evidence for policy can be classified into a number of types and components. Firstly, there is structured quantitative data (e.g. census, administrative data, government surveys); then there is semi-structured material (this includes qualitative and 'grey' data) (Fry et al. 2012). Next there is the analytical reasoning that sets these data in context. Thirdly, then are the opinions of stakeholders on all of these issues. In evidence-based policy making, if weaknesses are found in the data upon which policy options are based, then there may be the

need to fall back upon the analysis that apply to the data. If there is any weakness in the analysis, or any risk that others could bring an alternative interpretation to the table, then it is up to the stakeholder base in order to understand the different interpretations that could give rise to different analyses of the same set of data (Defra 2011). This is interesting to consider in terms of mapping processes as many weakness may go unnoticed, especially given the scientific austere of maps provided with GIS.

Marston and Watts (2003) similarly categorised evidence through a social sciences perspective as either 'hard' or 'soft', implying objective versus subjective forms. Hard evidence is said to consist of: primary quantitative data collected by researchers from experiments; secondary quantitative social and epidemiological data collected by government agencies; clinical trials and interview or questionnaire-based social surveys. This is in contrast to 'soft' evidence which is viewed as consisting of qualitative data such as ethnographic accounts and autobiographical materials. According to Sutcliffe and Court (2005), such categorisation is risky as it can create hierarchies where hard evidence is prioritised. Tacit forms of knowledge, practice-based wisdom and, perhaps most importantly, the voices of ordinary citizens - the 'voices of the poor' - might be ignored, as they are low in the hierarchy.

According to Crampton (2010):

"Categories are useful, but at the same time they encourage some ways of being and not others. Often, some ways of being are accepted as somehow typical and are called 'normal', while others are called 'abnormal'. Then there is a tendency to try and correct, eliminate, or manage the abnormal".

(Crampton, 2010, p. 9)

This thesis specifically focuses on how rural Wales (a category) is known though the use of social and economic statistics (categories). Statistics would be classed as quantitative hard facts and, therefore, may have priority. However, when mapped they may in fact be just as subjective, and may in fact mask issues simply by appearing scientific.

It is useful to reflect on how social and economic statistics are used with geographic information from a technical perspective and follow how those mapping rural statistics combine these data in practice This is important to discuss here as it

provides the context for the rest of the thesis. Social and economic data or population-related data refers to information originating from individual members of a population. A population scattered across geographic space and clustered in households. Well-known examples of social and economic statistics are available from UK censuses² and other (less comprehensive) population surveys (that are more dependent on statistical sampling frames). They are also available from the records collected by health authorities, local government, and the service sector (Martin, 1991). These data are contrasted with those that relate to physical objects with more fixed or permanent locations, such as a forest, a geological structure or a road network. Social and economic data also differs, as it cannot always be directly observed. Both human and physical objects are joined by the notion of geographic space and time for mapping purposes. Time is frozen and space is made to appear uniform.

To quantify: social and economic statistics in rural areas require defining a territory. Defining 'rural' for any form of quantitative analysis tends to require creating boundaries of some sort. A boundary that is modifiable even in quantitative terms. A classification of what counts as rural and what is not rural has therefore been performed; any subsequent calculation in order to achieve headline figures or to show areas eligible for funding or political intervention tend to be based on these definitions and classifications. Harley (1989) has examined these dualisms in terms of science. They are created in order to defend a territory.

"Classification is part of the way in which science claims to control and mirror the world".

(Harley 1989, p. 6)

There are three main classifications used for collecting quantitative evidence of social and economic statistics or allocating funding. There is a local authority (LA) classification which classes 'rural ' as The Isle of Anglesey; Gwynedd; Conwy Denbighshire; Ceredigion; Powys; Carmarthenshire; Pembrokeshire; Monmouthshire. Then there is also a sub-LA classification called the ONS urban rural classification. The classification was produced using a 1-hectare (100m x 100m)

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² In fact the Population Census in the UK is a special type of total population survey as the aim of the survey is to obtain information from every member of every household. Despite this aim information is never achieved from 100% of the population and needs to be accounted for statistically post-survey.

cell grid covering Wales. Density profiles were created for each cell in the grid. The cell profiles were aggregated to output areas and then to administrative units. This identified three main types of settlement forms: 1) **Urban (>10k population)**; 2) **Small Town and Fringe**; 3) **Village, Hamlet and Isolated Dwellings.** The density profiles were then also given context by looking at a 30 km distances around each cell. This provided a measure of sparsity enabling each settlement form to be divided into: **Sparse areas** and **Less Sparse** areas (Bibby and Shepherd 2004). This classification can then be used to highlight predominantly rural wards by combining settlement form and sparsity.

Another definition has also been produced for the Welsh Assembly Government Consultation on the Draft Rural Development Plan for Wales 2007 – 2013. This definition classifies Wales initially using the ONS 2004 classification and then refines this classification through consultation with LAs.

Firstly, the classification splits settlements into 'sparse' or 'less sparse' categories and then subdivides these according to whether the areas are large towns, small towns or 'other' i.e. small to medium sized settlements. Once the settlements had been split, officials reviewed each area type and agreed initial conclusions about their likely character. Next, the classification was advanced by the WG through working with Welsh LAs to consider qualitative criteria, such as settlement and population characteristics; economic activity; culture; access and communication at the local level to draw out the other arguments for defining areas as 'rural'.

The Consultation on the Draft Rural Development Plan for Wales 2007 – 2013 resulted in the following classification:

Rural Ward - A ward with a solely or predominantly 'Rural' or 'Small Town' Output Area population profile or where non-statistical evidence provided by the LA supports the rural nature of the ward. Projects can be located in the ward with the full benefits arising from the project accruing to it (Welsh Government 2007b).

For a more detailed description on rural classification, see 'A statistical focus on rural Wales' (Welsh Government 2008). These classifications will be referenced throughout the thesis.

1.4 Why a Case Study of Wales?

Wales provides residence to roughly 3 million people within a land surface of 20 thousand km². Most of this land mass is classified as rural yet most people condense their lives within urban settlements. It is relatively small in population and land area compared to other European Countries.

Wales has for some time has arguably been a distinct political and administrative entity. Therefore, it is conveniently prepackaged and bounded. Moreover, it is possible to travel to North Wales within a day by car. As the research was conducted on a part-time basis, these were important pragmatic factors that led to the decision.

Living for most my life in Wales has also provided deep insight into the nation and working at the WRO using GIS ensured somewhat of a head start in the subject areas of this thesis. Moreover, a number of key contacts had already been developed.

Wales had recently undergone a period of significant restructuring of the policy-making system. Devolution provided Wales with legislative powers, which set the nation on a pathway towards greater autonomy and increased decision-making capabilities. However, Wales remains funded through Westminster and lacks control of key economic levers, e.g. taxation and welfare. Wales is also heavily funded through the EU. The socio-economic wellbeing of rural Wales is inextricably linked to the performance of the Welsh economy and that, in turn, is heavily influenced by UK Government policies and the state of the global economy.

The Welsh Government (WG) does have powers in a number of key policy areas that can be used for developing rural Wales. These included agriculture, economic development (certain areas), tourism and planning. As such, devolution has created the potential for distinct policies and programmes to be developed that address the needs of interests of rural Wales. It is now recognised as a distinct policy area. The WG have adopted a 'bottom up' approach to rural policy development with an emphasis on local government and partnerships (WRO, 2004). This all makes Wales an interesting place to study, especially as devolution has provided an arena for policy making within which it can cast a lens upon itself in order to better understand where to use its powers. Since 2003, Wales has had a GI strategy to guide a relatively small network of people mapping GI on behalf of each organisation.

There were relatively few local planning authorities in Wales and therefore the scope of the study becomes realistic if focussed on these collectives. The size of the mapping community within Wales also ensured that the research was manageable and that any views expressed were likely to outline current issues in practice. An interesting dimension is added, in Wales, because the public sector has a responsibility of providing material and signs in Welsh as approximately one in five people could 'speak Welsh'. If maps, like pictures, have meaning worth thousands of words then they are also a potential money saving device.

It should be noted that the research was conducted during a time of international financial constraint. Global economic problems that emanated from the late 2000's recession meant that broad political and economic factors were affecting Wales as well as other countries. Also, since the research began, there has been a change of UK government. The Conservative Liberal Democrat Coalition has introduced public spending cuts (June, 2010) and a Comprehensive Spending Review (CSR, October, 2010). Planned reductions in public expenditure have been described by ministers as 'progressive', although independent analysis suggests that cuts in benefits and public services are likely to have an adverse impact on low-income households and groups (Browne and Levell, 2010). The budget cuts will affect the delivery of services in Wales but the policy direction will remain distinct in many areas. Changes in the reorganisation of health, housing, local government, education and social services will not necessarily impact Wales or be 'reengineered' as envisaged in England. However, changes to the public sector are already unfolding. For example, collaboration across LA borders is being suggested as a means of maintaining public service delivery (Rhys Davies et al., 2011). With budgets and resources exhausting, it is interesting to see how the role of mapping for policy making unfolds; will mapping be increasingly used or pushed to the sideline?

This research inadvertently explores mapping practice for policy making during times of austerity. In some ways, these circumstances are not so unique as the country was also headed towards recession around the time the Chorley Report was being conducted (see Chapter 3) in the late 1980's. At that time, GIS was only beginning to be used by Government and mainly for utility management and land use. The Chorley Report concentrated mainly on the human factors of GI and GIS for government. By focusing on the human aspect of GI and GIS, the report transcended the rapid changes in hardware and software and ensured many of the findings are as equally relevant today as they were over twenty-five years ago.

1.5 Taking Stock - Maps for Policy Making in Wales

In 2012, the RTPI investigated how a fully integrated national mapping framework for the UK was developing through the interplay between policy needs and spatial contexts (Wong et al. 2012). The project demonstrated the disparate role and uncoordinated practice of using maps to represent spatial knowledge within policy documents.

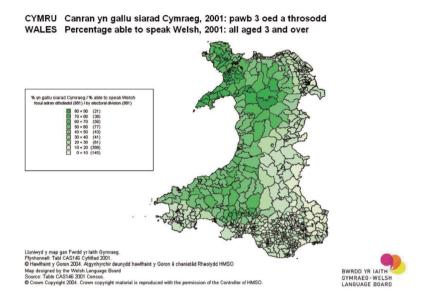
A similar study was undertaken at Cardiff University. The study by Beaney et al. (2013) investigated a range of what was termed 'spatial expressions' of government policies and programmes and cross sector connectivity relative to the Wales Spatial Plan (2004, 2008). In essence, the England project was replicated and fitted to Wales.

The study appraised over one hundred and fifty documents and found that 37% contained maps and almost half demonstrated the spatial implications of policies. The project only focussed on national maps but found that the onus was on LAs in Wales to implement the spatial aspect. The study found that examples of mapping social statistics were small in comparison to economic and environmental topics. It was discovered that maps were not always utilized in policy development and particularly for social policy. Where maps were used, the vocabulary and use of language varied. In addition, mapping tended to be for descriptive analysis of existing data rather than for predictive approaches.

However, it must be noted that this investigation appears to have classified some social statistics as economic and vice versa; for example, the welsh language. Undoubtedly, this is due to the 'fuzzy' nature of the terms 'social' and 'economic' and the role that culture plays amongst these. However, it must also be noted that from *a priori* experience of working in this area, that this project has overlooked several key mapping portals, and several documents that included abundant 'spatial expressions' using social and economic statistics.

Take, for example, some of the limited examples of social maps demonstrated (e.g. Figure 1.1). These examples come from reports that contain a multitude of social focussed maps.

Figure 1.1: Location of Welsh Speakers Ages 3 and Over (in Rural Health Plan)



(Welsh Goverment 2009, p. 14)

This document draws upon maps from other reports undertaken, for example, by the Welsh Language Board. This organisation has recently produced several other maps and demonstrated the use of alternative mapping techniques such as cartograms, and point mapping.

Figure 1.2: An Example of a Cartogram (Welsh Language Board, 2011)

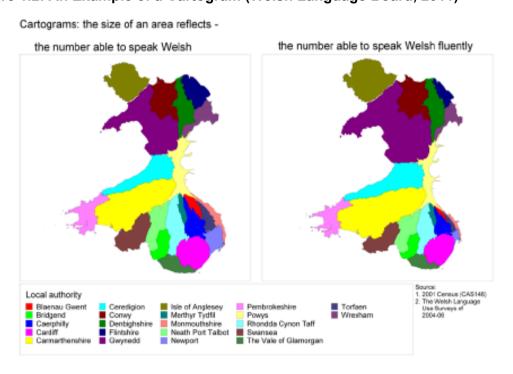
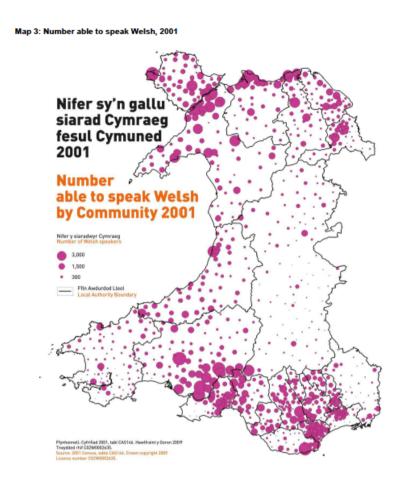


Figure 1.3: An Example of Point Mapping (Welsh Language Board, 2011)



What this research project helps to illustrate is that there is potential for mapping practices to take place and not make their way in to final policy documents. It also illustrates how maps can be produced once but used many times within policy reports. Due to the fragmented nature of mapping, there is also the potential for multiple organisations to be mapping the same data but representing it in multiple ways.

Drawing on the example of the maps used to represent Welsh speakers used in the report, it is clear that there is more to mapping than appears in a final policy document. For example, if multiple organisations are producing maps, the choice of inclusion in policy documents is just as selective as the data that goes into the map in the first instance. Moreover, the example demonstrates that in formal policy documents possible preferences may be given to the types of thematic maps, which represent data in a manner more familiar to the intended audience. This choice may just as much affect how rural statistics are represented than any prior mapping methods.

One final point to take from this example is that the Welsh Language Board, the source of maps in the Rural Health Plan, has been abolished and brought within the WG. This illustrates that the constant reorganisation within government departments may have unintended knock on affects for other organisations reliant on their mapping services; not only this, but there may be issues linked to the succession of mapping knowledge and practices in distinct policy areas.

1.6 Aims and Objectives

This thesis provides an original contribution to knowledge by directly addressing the deficit in our understanding of mapping practices that focus on rural statistics. In so doing this research explores practices not commonly revealed for scrutiny demonstrating hidden barriers and arenas for decision-making.

The epistemological and philosophical approach taken is centred on mapping as a process of knowledge construction and as a social-material area for critique. The goal of the thesis is to provide insight into the hidden ways in which maps 'do work' during policy making; in so doing, the thesis should not only provide an analysis of the technology and semiotic meanings involved in rural visualization, but also the influences of social-political structures, causing policy maps to emerge and cause action. This should result in a theoretical framework that will have wider relevance to rural stakeholders in the rest of the UK and in other Western countries.

The overall aim of this thesis is to contribute to the understanding and improvement of the scientific visualization component of map use, especially when applied to rural statistics for policy making in Wales within the context of existing institutional arrangements. This will be achieved through a critical examination of the interactions between people, technology and rural statistics that take place within organisations. In doing so, a theoretical understanding of rural mapping processes in practice will be developed.

To achieve these aims, a number of objectives will need to be accomplished:

- A synthesis of diverse literatures linked to scientific visualization, rural statistics, cartography, GIS, organisations and planning theory in order to frame and contextualize the research project.
- Document and reveal the extent to which barriers found in the Chorley Report

- (1987) have been resolved in the UK. Outline the potential consequences for representing rural statistics in Wales for policy making.
- Highlight differences and similarities in how rural statistics are represented and understood by the WG, the Data Unit-Wales and Welsh LAs.
- Evaluate the benefits and limitations of mapping rural statistics by seeking the
 perspectives of those providing evidence for policy making in practice and
 contrast mapping practices of key individuals within the same organisation.
- Provide a critical assessment of the changing nature of mapping in Wales and the introduction of new technology (i.e. InfoBase systems).

Responding to these objectives will ensure the research questions of this thesis can be answered throughout the thesis.

1.7 Research Questions

The research questions of this thesis are outlined below, in reference to Wales:

- What are the benefits and limitations of scientific visualization for policy making?
 - What factors limit the scientific visualization of rural statistics for policy making and how could this be improved?
- What has happened in Wales since the Chorley Report with regard to the use of GI and geospatial technology?
 - How does this affect the ways in which rural statistics are produced, understood, stored and communicated and contested?
 - How reliant is mapping on technical and social factors?
- How are maps currently used to represent rural statistics for policy making and planning?
 - o Why is mapping used?
 - o How does this vary between and within organisations?
- How are the current dynamics of mapping changing in Wales?
 - What role do data custodians now play in mapping rural statistics in Wales?
 - How can mapping affect communication and decision making within collaborative environments?

1.8 Methodological Approach

A key postulation underpinning this research is that rural statistics are fundamentally different to those for urbanised areas when spatially represented; however, there appears to be little evidence of how to account for this distinction. This thesis explores this issue by focusing on people, maps, places, spaces, processes, technology, institutions and the acquisition and communication of information and knowledge. To study mapping processes within policy making, a qualitative case study approach has been adopted in Wales. An inductive research process will be used to derive theory from the observation and interpretation of key individuals working with rural statistics in practice for evidence-based policy making. Although aspects of grounded theory method are applied, attention is given to existing theories in offering 'sensitising concepts' (Charmaz and Belgrave 2002; Charmaz 2011) for explanation the interpretation. The aim is to improve understanding of a complex phenomenon in context.

Evidence was gathered in several ways and included a detailed examination of academic literature and policy reports; observation within the working environments of the WG; the Data Unit-Wales and Welsh LAs; the collection of artifacts and by conducting a series of interviews over time.

Research was also divided into several stages. The first involved a desk-based analysis of academic texts; policy documents and the Internet to explore the key concepts within the research within the context of Wales. Next, a research strategy was developed; appropriate methods designed and materials created for the collection of evidence.

The second stage of research involved establishing contact with a gatekeeper to the institutions of interest. A meeting was set up with the Data Unit (DU) to explain the research concept and develop access to key individuals involved in mapping social and economic statistics in Wales. A series of interviews were then conducted over a period of time to explore from the interviewees' perspectives on the concept of mapping social and economic statistics for rural Wales.

The third stage was conducted after a basic thematic analysis was conducted on the interview transcripts from the second stage of research. This was used to focus a third stage of research that evidenced more detail on the mapping practices within a

LA. Interviewees were observed as they undertook mapping tasks and how these maps were subsequently used was explored.

A final interview was also then conducted with additional key spokespersons at the DU. As the research was undertaken on a part-time basis, several years had passed between the beginning of data collection and the final interview. This added a quasi-longitudinal element to the research design and enabled the research to uncover short-term change from direct experience.

1.9 Structure of the Thesis

To address the research objectives and answer the research questions set out in this section, the remainder of this thesis is divided into seven chapters.

Chapter 2 provides an overview of the technical literature that has developed on the representation of people and places. It mainly comes from the field of cartography but increasingly draws from the field of statistics and computer sciences. The latter half of the chapter discusses how many of the assumptions and developments within this field are not as scientific as they first appear and introduces key concepts from the critical cartography and GIS literature. It shows that mapping is very much a human-centered issue.

Chapter 3 explores the use of maps and geospatial technology within organisations. It explains how the Ordnance Survey (OS) and the Chorley Report, in 1987, instigated the use of geospatial technology for handling spatial problems within government. It reflects on the barriers encountered for organisations attempting to adopt these technologies and the theories of how these technologies function. The literature here suggests that mapping within organisations is about social interaction.

Chapter 4 provides the context for this study in terms of the current conditions for policy making in Wales and developments since the Chorley Report. This section sets out the contexts within which the research was conducted in Wales.

Chapter 5, 'Methodology and Methods', will review the methodological approach and methods used in the empirical gathering and analysis stage of the research. This will be done through reflection on the research questions and the methods that will be

used to attempt to answer them. It will then examine the methodological approach taken to collect and analyse empirical data, using a case study approach. Each of the multiple stages to the methodology will be discussed as well as techniques for data collection and the selection of the interviewees. Participant observation, interviewing (key stakeholders), data analysis, ethics, bias and reflexivity, will all be discussed in full.

Due to the way this research was conducted, there will be a number of reflective empirical sections in Chapter 6. The first looks at the type and form of mapping for policy making in Wales. It will document and explain the case study environment and ascertain how rural statistics are represented for policy-making purposes. Next, a section will be devoted to demonstrating two detailed cases of where maps have been produced to guide policy, exploring the often hidden and unspoken activities. The final section will reflect on changes to the ways maps are being used for policy making in Wales. Throughout this chapter findings are discussed in line with the central principles from the conceptual framework developed and the additional evidence collected.

The final chapter discusses the key findings from the empirical study and discusses these and the implications for policymaking. It concludes by explaining the theoretical and practical implications emerging from the findings of the study and ends by suggesting the potential for future research opportunities.

Chapter 2 – Technical Horizons and Unstable Foundations

Introduction

The literature review conducted as part of this thesis is presented in several chapters. This first chapter focuses on the concept of the map and the technical aspects of mapping for cartography. The chapter is split into two sections. These sections demonstrate how cartography came to be understood as a science and how the discipline came under increasing scrutiny from critical and cultural geographers. There is currently somewhat of a tension within the literature. Most notably between cartography and scientific visualization, and critical cartography. The former is focussed on improving techniques and technology. The latter questions the validity of maps as scientific tools; how they are used in practice and the motives behind their construction.

Despite the literature often contradicting each other's epistemological and authoritative claims, each link to the key concepts within this thesis. Hence, it is important to consider each and reflect on how they can be used to create a theoretical framework within which to study the representation of rural statistics in policymaking. Moreover, it is important to consider how both offer perspective on map use in organisations (this will be discussed in Chapter 3).

This thesis is about networks of people working in organizations and focuses on their attempts to represent people and places for both themselves and the interests of organizations. People have been striving to represent people and places through the use of maps, scientific drawings and data plots for many years. Many sophisticated geographic maps were drawn before attempts to display statistical material (such as detailed population characteristics) within them (See Figure 2.1). However, it was not until the seventeenth century that the statistical and cartographic skills came together to draw a data map (Tufte 2001).

According to Tufte (2001) one of the first data maps was used to show trade winds and monsoons on a world map, it was created around 1686 by Edmond Halley. Later came examples of applications that quantified characteristics of people.

Famous examples include the dot map of Dr John Snow³ (1855) who plotted the location of deaths from cholera. This was an early example where a map was used to back up evidence and cause a change in the world (to get the Board of Guardians of St James's parish to remove the handle from the infected pump). Another famous example is Napoleon's invasion of Russia in 1812, by Charles Joseph Minard (1861) that counted quantity and direction by combining a data map with a time series.



Figure 2.1: Map of China's Coastal Land using 'Li' (1137)⁴

Spécimens de la Cartographie Chinoise,' Bulletin de l'École Française de l'Extrême Orient, 3 (1903), 1–35, Carte B.

(Chavannes 1903; Nelson 1974; Hapgood 1979)

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³ Shapters original 1849 publication of "History of the Cholera in Exeter in 1832" published dot maps which were thought to have influenced Dr Snow his decision to use his own maps. See Brody, H. et al. 2000. Map-making and myth-making in Broad Street: the London cholera epidemic, 1854. *The Lancet* 356(9223), pp. 64-68. ⁴ A 'Li' refers each square in the Chinese grid system

Up until the middle of the 20th Century cartography was used as a means to both keep order in society and to navigate, but the cartography that emerged has been considered by more akin to art than a science (Sluter Jr 2009). Despite this elements of modern cartographic practices can be witnessed in even the earliest of maps⁵. Krygier (1995) critiques the use of the art/science dualism and instead calls for a process oriented means of understanding cartography. Within this process, "art" and "science" serve a functionally similar role, informing the different ways in which we come to know and re-know our human and physical worlds.

Cartography, by definition, was a "science" in 1949, an "art, science, and technology" in 1973, and is now neither an art nor a science (Krygier 1995).

Regardless the map, as a metaphor, is enduring through time and capable of transferring geographic information between places. It does so through reducing what is familiar through a system of coding and symbols. Mapping is therefore caught somewhat between abstraction and realism.

This distinction, between the different ways of knowing about maps, can be framed within a much broader rift that emerged in the field of geography in the 20th Century and has come to encompass all that is now geographical. A network of cultural geographers emerged and began to question positivist and related post-positivist ways of knowing. As the geographic theoretical debate increased and diverged, so too did perspectives on how maps worked. Some treated the map as an objective tool used to measure the world while others highlighted its subjectivity as a social construction. Despite this maps remained common. As geography became divided in how to treat cartography as a field, important research continued to flourish in both camps but did not necessarily come together until they were forced to do so with the proliferation of computing bringing cartography and scientific visualization into the heart of organizations and perhaps more critically in to contemporary policy making arenas.

2.1 Positive Intention - from Semiotic Systems to Distributed GIS

The following section tracks the development of geospatial technologies for representing rural statistics. It shows how the field of semiotics became an integral

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⁵ Note the use of the integer grid in Figure 2.1

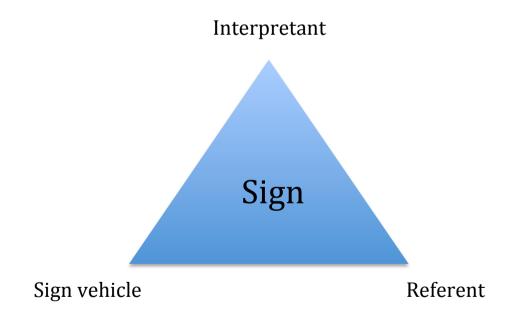
part of representing GI within maps and within geospatial technologies. It also shows how scientific visualization has changed the way in which maps are used and spawned the field of geovisualization in which people are integral to mapping processes.

2.1.1 Signposting graphics in science - the field of semiotics

Semiotics, the science of signs (i.e. signification) and sign systems, underlies much of the technical studies related to representing quantitative models of the world. It offers one approach to creating a semantic framework within which the meanings associated with GI in collaborative environments can be understood and managed.

A fundamental concept in semiotics, introduced by (Peirce 1902), is the 'semiotic triangle' depicted in Figure 2.2. There are three major components: the referent, the sign vehicle and the interpretant. These come together to form a sign.

Figure 2.2: The Semiotic Triangle (Peirce 1902)



In its simplest terms, the triangle can be explained so that referent is the entity to be represented (this could be a house, a road, or even a person and their characteristics). The sign vehicle stands for the referent (e.g. a point, a line, an area). It serves as another object that can summarise information and focus attention (it could be a point representing a house, or a person, or a line representing a road; it

could even be an area showing the predominant social or economic characteristic). The interpretant is the meaning or interpretation derived by a user from the sign vehicle about the referent (for example, a policy maker might consider a cluster of points representing houses as an urban location). Semiotics applies to the visual display of quantitative information and spans both geographic and non-geographic data⁶.

Both statisticians and cartographers are aware of the utility of locating symbols on a plane to show the statistical distribution of one or more variables. Cartographers map geographical datasets using the two dimensions of the plane, but use this space to portray spatial location. Statistical graphics of datasets that are not georeferenced often make use of location to graphically depict differences between data values (Dykes 1999).

John Tukey was somewhat of a pioneer in bringing statistics and their representation together for exploring scientific data and even predicting election results in the U.S. He developed many of the tools of modern statistics and developed the Exploratory Data Analysis (EDA) approach⁷. The EDA approach focuses explicitly on "looking at data to see what it seems to say" (Tukey 1977, p. v). In this sense he was somewhat an advocate of empiricism.

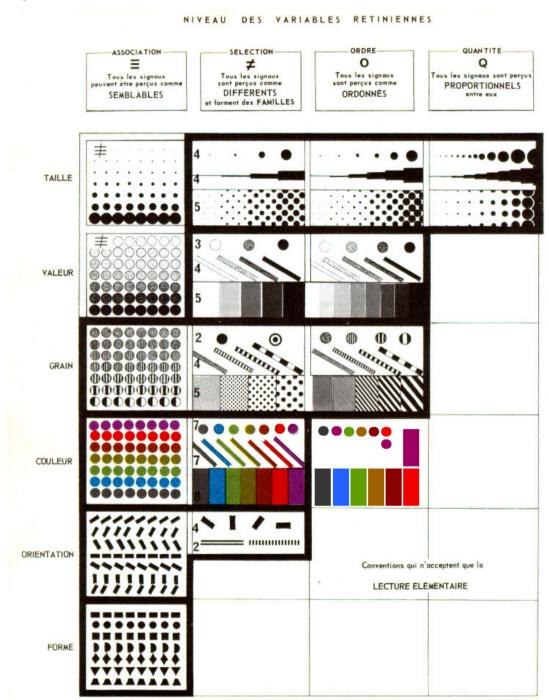
Bertin (1967; 1983; 2010) in his celebrated work, 'The semiology of graphics', outlined a range of graphical symbols and techniques, available for use in data representation and cartography. He identified that every graphic representation is made by a series of basic components that have different expressive power and that each one works best only in some conditions. Bertin suggested basic variables: size, value, texture, colour, orientation, shape and, for each one, he pointed out in what cases they work best and how to use them as a foundation for understanding and presenting complex data (Al-Kodmany 2002).

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⁶ Note that semiotics can also apply to ideas, for example, and somewhat paradoxically, the semiotic triangle in Figure 2.2 has been used as a sign vehicle so as to understand the concept of semiotics.

⁷ He also introduced concepts central to the creation of today's telecommunications technologies and reportedly coined the terms 'bit' and 'software'.

Figure 2.3: Visual Variables for Visual Quantification



(Bertin 1967)

These variables can be used in the production of statistical maps. Several authors have attempted to apply the principles to cartographic design since and resulted in many variants (Figure 2.4). Some academics have focussed on particular aspects, for example, Brewer (1989a) began experimenting with colour and cognition. She developed this specific theme throughout the 1990s and has more recently started

applying concepts to practice (Brewer 1989b, a, 1992; Brewer and Marlow 1993; Brewer 1994a, b, 1996; Brewer et al. 1997; Brewer and Campbell 1998; Brewer and McMaster 1999; Suchan and Brewer 2000; Brewer and Pickle 2002; Brewer 2003, 2004)

Best to Lines **Points** Areas show possible, but too qualitative cartogram Shape differences weird to show quantitative cartogram Size differences Color qualitative differences Hue Color quantitative differences Value qualitative Color differences Intensity qualitative & quantitative Texture differences

Figure 2.4: Visual Variables for Thematic maps

(Krygier and Wood 2013)

Many cartographers have also developed techniques for symbolizing one or more statistical values at locations in space, from which geographers and other spatial scientists can assess distributions. Techniques include combining length, area and repetition to shape or breaking down position in the three dimensions of space and one time dimension. In addition since nowadays computers process and present information, the addition of motion as a new visual variable becomes important. Changes in motion can include direction, speed, frequency, rhythm, flicker, trails, and style (Carpendale 2003). Therefore time is a new dimension both inside and outside of the map suggesting a new era of interactive mapping.

Maps that allow a high degree of interaction permit brushing, panning, zooming, rotation, dynamic re-expression (where the map is automatically updated after a change has been made) and dynamic comparison (linked views) as part of their functionality (Dykes 1997). A linked view allows the user to select a point in one map to identify its location in another, for example (Orford et al. 1999). Therefore the basic variables for mapping have now changed but still build on similar semiotic principles. However the emphasis has swung from being contained within the computer interface to the human dimension that sat outside the computer interface.

2.1.2 Mapping as a Communicative Science

Following World War 2, in the 1950's, cartographic research began to adopt the scientific approach to map making⁸. This was partially in response to the influx of propaganda mapping during the war, from which Robinson (1952) realised visual relationships in maps mattered. It was assumed that the content of a map could be used to manipulate the impressions provided to the end-user. In an attempt to make mapping more objective Robinson sought to develop a scientific approach to map making so that maps could become consistent in content and style.

Robinson's (1952) 'The Look of Maps' sought to establish a better cartography through improved cartographic techniques. Robinson notes the importance of visual technique and the importance of colour, style, lettering, and map structure/design. As such, The Look of Maps put forth the proposition that the function of maps was to communicate to people. This function depended on the visual appearance of maps, and this appearance, in turn, depended on explicit and implicit design decisions made by mapmakers. So to understand and improve map function, cartographers needed to understand the effects of design decisions on the minds of map users. A new field of cartographic research was emerging based on semiotics:

"The work that makes the data intelligible to the reader ... is the essential cartographic technique"

(Robinson 1952, pp. 3-4)

people or war. War emphasized important ways in which maps could be used, particularly to strategically plan and organize people and spread messages of control and order

⁸ It is interesting to note how most of the surviving maps are linked to either the control of

In the past, cartographers had rarely made map design principles explicit, Robinson claimed; a state of affairs that needed to change. Furthermore, he proposed that the best way to understand map communication was the way other mysteries of the world were being understood at that time, through rational thought and systematic study. This provided an early blueprint for cartography as science (Montello 2002).

The communication-driven paradigm for cartography gained momentum in the 1970s. This involved the map as a device with which it was possible to communicate information from cartographer to map user without distortion. To do so required removing the problems from within the map. Borrowing from the communications system theory, these researchers attempted to find a scientific approach to cartographic theory that would allow for more structure in cartographic research and provide more reproducible results (Robinson and Petchenik 1975). Therefore this work aimed to advance Robinson's earlier cartographic techniques.

Seeing maps as communicating known information to map users, the communication approach understood mapping as a multi stage process. Firstly, a phenomenon that is to be studied is sampled and a data set assembled. Then the cartographer interprets the data, based on various classifications and/or interpolation schemes. Employing this analysis, the cartographer then decides on a design for the map, which is produced by employing best practice design principles in an attempt to create a map. The aim was to provide an optimal representation of the data and the nature of the phenomenon under investigation. In the final step of the process, the user interprets the phenomenon based upon the cartographer's ability to correctly communicate his or her ideas. There was a pursuit to find the 'optimal map' that would communicate known information with as little "noise" as possible (Sluter Jr 2009). However, due to the inherent social nature of mapping, this approach has come under criticism (Section 2.2).

2.1.3 Cartographic Practice in Technologically Diffused Environments

Donald Knuth (1995) asserted: "Science is what we understand well enough to explain to a computer. Art is everything else we do."

(Knuth in Petkovsek et al. 1996, p. vii)

This view appears to encapsulate the drive of science during the late 1950's and resulted in a lot of effort being put into the moving of cartography into the computing discipline. The computing discipline is heavily interwoven with hardware and technology. However what was overlooked at the time was that it was also dependent on people and organisations.

Tobler (1959) was one of the pioneers in producing a simple model called MIMO (Map In - Map Out) for applying computers to cartography. The principles of the MIMO system (a map input, map manipulation, and map output) created the foundation for data capture, data linking, data analysis and display used today. The MIMO system contained all of the standard elements found in GIS software. Despite this the Canada Geographic Information System is considered one of the earliest GISs developed and was created in the late 1960's (Clarke 1997). Soon after in the U.S. the Census Bureau began to adopt these techniques and apply them to resident addresses and this in turn to the residents characteristics. The challenge was of matching the addresses on the responses to a map, so that the spatial distributions of the responses could be analyzed. To meet this challenge, the Census Bureau developed a system known as Dual Independent Map Encoding (DIME). This enables spatial relationships between landscape features to be queried. It is referred to as topology (Longley 2005).

Prior to the late 20th century, paper maps and statistics were probably the most prominent tools for researchers to study their geospatial data (Kraak 2003). When computer began to be used for mapping it mainly took place on large minicomputer workstations. Computing was for specialists working in often devoted laboratories. Throughout the 1980's and 1990's, desktop computers became the dominant type of computer and multiplied in homes and in the workplace, becoming increasingly portable and powerful into the 21st century. In the 1980s and 1990s, many GIS applications underwent substantial evolution in terms of features and analysis power. Private companies who could see the future commercial potential of this software were refining many of these packages (Longley 2005).

Computer graphics played an increasing role in studying scientific problems. Prior to the 1990s the lack of computing power limited the use of graphics but this has now changed. Powerful processors have enabled computer intensive methods to be used widely and human-computer interfaces have improved enormously. A major development has been that of integrated software for the capture, storage, analysis

and display of spatial information in the form of desktop geographical information systems (GISs). There has also been an explosion in the quantity and availability of spatial data from a variety of sources, such as satellites; digital maps; the global positioning system and so on. The availability of GISs has facilitated the processing and mapping of spatial information in a wide range of public sector disciplines during the 1990s, as well as in commerce and industry (Unwin and Unwin 1998).

This history of cartography and scientific visualization has shown that as technology changes so too can the principles and techniques. Computer technology can allow for a multitude of representations of a phenomenon. These can be used to answer different questions posed by researchers and reveal previously unrealised trends in data often locked within databases. There are also host of electronic media and methods through which the representation of spatial information can be constructed (Dykes 1997). Just as computer developments influenced GISs, the development of new interactive graphical tools extend the exploratory data analysis tools to the map (Unwin and Unwin 1998).

Now there are new methods to represent multiple data values and much data is no longer restricted the use of the plane to show location. This is because of linking techniques, and the fact that maps can now be produced rapidly and even animated. Many early principles therefore need to be reassessed in light of changing technology and the social environments in which these technologies exist and the social and economic problems to which they are applied.

The rapid progress in computer technology, afforded by the ever-present personal computer in the last two decades, has led a number of researchers to suggest maps now function in new ways. But does this mean maps can be applied to new problems or offer a new lens on existing ones? Many of these developments have contributed to a confidence in the use of graphics at the exploratory stage of the research process where spatial data are viewed and reviewed under changing cartographic conditions in an attempt to elicit patterns and trends, which might be present, and to assess their validity. But is this being done within policymaking?

2.1.4 The Field of Scientific Visualization

The recent reemphasis on semiotic principles for visualization started in 1987 with the special issue of Computer Graphics, on Visualization in Scientific Computing. Prior to this time, different academic fields were making use of visualization in different ways, which resulted in an uncoordinated discipline. The report by McCormick et al. (1987a) brought visualization back into focus and described its uses. According to their report, Visualization in Scientific Computing (ViSC) is a computer-based field that can be used to solve a wide variety of problems using common tools, terminology, boundaries, and personnel. They explain as a technology, Visualization in Scientific Computing promises radical improvements in the human/computer interface and may make human in-the-loop problems approachable (McCormick et al. 1987a). By this they mean that the application of computers to problems is more than a one-way process it is iterative and requires human judgment. Scientific visualization was perceived to assist in these judgments by providing representations that could offer insight in to large datasets.

McCormick et al. (1987) define visualization as follows:

"Visualization is a method of computing. It transforms the symbolic into the geometric, enabling researchers to observe their simulations and computations. Visualization offers a method for seeing the unseen. It enriches the process of scientific discovery and fosters profound and unexpected insights. In many fields it is already revolutionizing the way scientists do science. Visualization embraces both image understanding and image synthesis. That is, visualization is a tool both for interpreting image data fed into a computer, and for generating images from complex multi-dimensional data sets. It studies those mechanisms in humans and computers which allow them in concert to perceive use and communicate visual information".

(McCormick et al. 1987a, p. vii)

An important point to take from this is that scientific visualization provides a method to 'see the unseen' within your data. This could prove useful when attempting to visualize rural data where the data message is often lost within vast areas or proportionally dwarfed by comparing to urban localities. McCormick's report is very computer technology orientated. The report focuses on human cognition and that 'real world' phenomenon are there to be accessed using appropriate technology.

Pickles (2004) questions the decisions made to bring us to the technologies we use today:

"Because the technologies with which we live more or less work as they are supposed to, we tend to not ask why or how any particular technology or ensemble of technologies work, or why they came into being in the first place. Most of the time, most of us take them for granted."

(Pickles 2004, p. 68)

According to Pickles (2004), we tend not to question design decisions, logic and rejected alternatives the led to the construction of the technologies with which we work today. We probably think even less about the political, economic and social contexts in which these decisions and choices were made, or about the ways to mobilise them in practice. Even when a problem arises, our first solution is often a technological fix for the problem instead of asking about the broader context of origins, development and practice within which the technology does not work.

In GIS individuals, technological objects, and institutional assemblages have functioned to naturalise one particular aspect of scientific practice. Therefore there is a need to understand the normative practice of science and its context in terms of specific practices, actors and institutions (Pickles 2004). In terms of research into mapping, it is therefore important to look at institutions and the people within them to understand how they use spatial representations in practice. It is not just about technology; hence it might be interesting to look back at the period between 1985 and 1995. This is when a lot happened in terms of the growth in desktop computing, the establishment of GIS and the emergence of a new visualization research field. Moreover this was the period where mapping became integrated within the UK Government. All these events were occurring simultaneously in parallel and sometimes overlapping. Regardless what is clear is that new theories have emerged in terms of how maps are used. These will be considered first before explaining some of the consequences in practice.

2.1.5 Key Scientific Visualization Theories

Early, important theoretical research and conceptual contributions DiBiase (1990) and MacEachren and Taylor (1994), among others, provide a framework for visualization research. From an Earth Science perspective, DiBiase (1990) explained that graphics are important in all stages of research projects and that they

are valuable not just at a project's conclusion (when figures need to be drafted for publication) but right from the start. He drew from the Exploratory Data Analysis (EDA) literature of Tukey (1977) and also from the reputable research of Jacques Bertin (1967; 1983; 2010). DiBiase (1990) suggested the research process can be split in to a four-stage sequence and this then could be related to visual thinking and communication, as shown in Figure 2.5.

VISUAL THINKING

VISUAL COMMUNICATION

Exploration

Confirmation

Synthesis

Presentation

PRIVATE REALM

PUBLIC REALM

Figure 2.5: Mapping to Think and Maps to Communicate

(DiBiase 1990)

This diagram could also be used to conceptualize the process of transforming rural data into public policies. However, the process may not be as 'one way' as the diagram suggests. This is because the research processes often involve a refinement of ideas after debate, leading to iterations back and forth between the private and the public realm of the researcher. Nevertheless, these ideas signify an important starting point on which to understanding scientific visualization and so an explanation of the diagram is necessary.

The first stage: Exploration

This stage involves examination of data to reveal pertinent questions. According to DiBiase (1990) finding questions to ask of data is becoming just as important as the finding the answer. This stage has become necessary due to the large volume of

digital data available. At this stage, the revelation of patterns and anomalies through visual representation is key. *DiBiase* (1990) suggests it is not essential that elaborate computer graphics be used to find unexpected patterns through visual methods. *DiBiase* (1990) states that visualization is a way of seeing, not just a method of computing and illustrates this with an example of how a simple sketch map can provide insight into a complex problem. In this sense it is an attitude or a willingness to look for what can be seen, whether or not it is anticipated. This stage of the process typically begins in the private realm of one or a few specialists who have quasi-theoretical insights or experience of similar data from the past.

The second stage: Confirmation

This stage involves finding relationships in the data. The confirmation stage occurs once a vague insight has been transformed into an explicit question. Techniques here can enable confirmation or rejection of hypotheses. For example it can display output from probability theory to look for errors. This stage is a critical stage of accepting, rejecting or refining a concept and, hence, particularly important to modelers. In models, visual representations not only bring into focus realities, they attempt to simulate but can also be used to refine the model itself (*DiBiase 1990*). As the data is in a more coherent form and not just a concept it can be shown to others capable of interpreting the model. Therefore this stage has begun to move away from the private realm.

The third stage: Synthesis

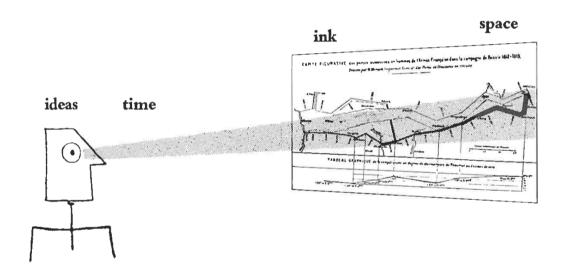
The synthesis or generalization of findings bridges the gap from the private to the public realms. According to *DiBiase* (1990) synthesis is the "transportation of a tentative personal investigation into a cogent public expression". This means that this stage involves summarising results of earlier stages. It produces a new integrated formation of how components in the model interrelate (*DiBiase 1990*). As a visual summary of the work so far it is transformed in to a more refined format. This makes the representation open for discussion with a wider audience.

The fourth stage: Presentation

By this stage, the purpose of the visual element has changed to focus on how messages can be communicated to an audience. Unlike in the earlier stages, where the audience is more likely to be an enthused group of familiar associates, the presentation stage will involve capturing the attention and the understanding of a much more diverse audience (*DiBiase 1990*). It is here where most maps for policymaking appear to reside.

According to Tufte (2001) it is here where expertise in graphic design is also needed for presenting understanding of a spatial problem, the goal should be graphic excellence. This involves the integration of substance, statistics and design to communicate complex ideas with clarity, precision and efficiency. Part of this goal is "that which gives to the viewer the greatest number of ideas in the shortest time with the least ink in the smallest space" (cited in DiBiase, 1990).

Figure 2.6: Presentation of Graphical Excellence



(Tufte 2001)

DiBiase (1990) notes that even with graphical excellence the presentation graphics must involve subjective judgment since vision cannot be shared directly. In this sense subjectivity escalates as the representation moves from the private to the public domain and becomes less reliant on the original data from which it grew.

An important point to take from this model is that the process is progressive in that decisions made at an early stage in assembly and exploration can have

consequences for what is acted upon later in the process. Therefore the process is just as important in the private realm as it is in the public. All stages are connected in ensuring the final image. In addition, during this process information is often selectively lost as the visual representation of data re-addresses its audience and therefore it could prove important that the knowledge of what is missing is somehow maintained (this could be done using alternative forms of multimedia).

DiBiase (1990) drew attention to the private-cognitive process of visual thinking. His model focussed on the need for researchers to direct attention to the role of maps at the early (private) stages of scientific research where maps and map-based tools are used to facilitate data sifting and exploration of extremely large data sets. Since other academics have suggested visualization is a key component of cartography. Showing how it is a meeting place for technology, communication and understanding

MacEachren (1994) have developed these previous theories most. Emphasising the use of visual displays for human computer interaction. The authors understand map use as a 'space' referred to as Cartography³ (Figure 2.7). This refers to the three axes along which map use has been characterised. The axis relates to the audience or the user of map (from private use to public) and the objectives of map use (from revealing unknowns to presenting things that are known) and the degree of interactivity with map or mapping environment (from high interactivity to low). This view of maps as a social construction provides a new frame of reference for understanding how mapping works.

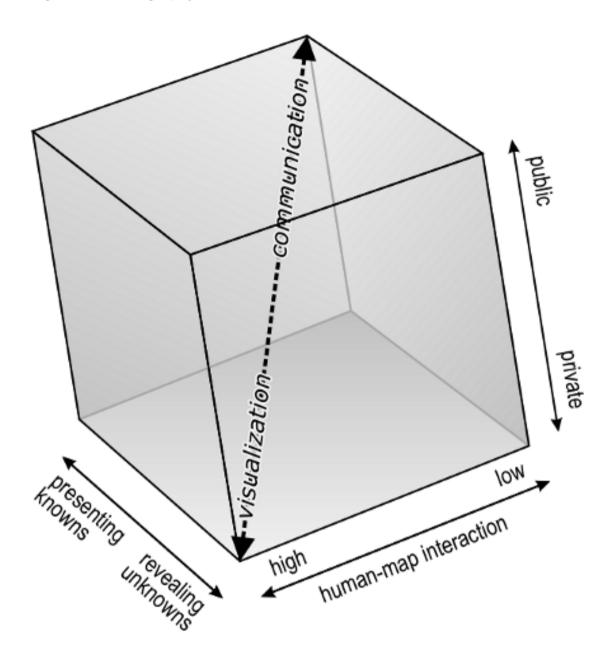
Mapping has incorporated new forms of interactivity made possible due to changing technology. In the space bounded by the three axes, visualization and communication are very much interlinked.

According to MacEachren and Kraak (1997):

"In this space, visualization is considered to be the complement of communication. All map use involves both visualization (defined loosely as the prompting of visual thinking and knowledge construction) and communication (defined loosely as the transfer of information), but map use can differ considerably in which of these activities are emphasised".

(MacEachren and Kraak 1997, p. 337)

Figure 2.7: Cartography³



(MacEachren 1994)

MacEachren and Kraak (1997) have related the corners of the cube to the idealised stages in a research project as suggested previously by DiBiase (1990).

They show how visualization can be used as a strategy to explore and to examine unknown and often raw data innovatively. Suggesting it is the dominant strategy at the 'private - high interaction - exploration of known' corner as there is usually an abundance of data available at this stage. This is in essence a 'getting to know the data' stage and is important as the better you know the data, the more accurate the

analysis will be (MacEachren and Kraak 1997). Important here are functions to explore the data visually to identify relationships among variables (linked views) and to 'see' the data from multiple perspectives (both spatially and conceptually). Therefore tools designed here need to be flexible and dynamic.

Visualization during the analysis stage generally involves manipulation of known data in a search for known relationships and answers to questions. Again, relatively private use is emphasised and facilitated through an interactive environment. MacEachren and Kraak (1997) provide an example from the planning process where two datasets are understood but their relationship still needs to be discovered (visual) and overlay analysis can let the relationship be seen. Required here are functions to target particular map components to extract information from them (e.g. focussing) and functions to process and manipulate that information.

When mapping is applied for synthesis of information it becomes more public in nature and geared towards groups of specialists. Mapping has moved from revealing unknowns to presenting findings. Mapping is used to extract the main patterns and relationships from the data and display them as a clear abstraction of the exploration and analysis process. Here the balance swings in the favour of abstraction rather than detail.

Presentation is strongly equated to communication in the diagram. However not only can it transfer some pre-determined 'message' it can also potentially prompt new insight from the audience in receipt of the presentation. Here emphasis is on public use of information that is known by the designer but still unknown to the person in receipt of the presentation. Presentation like the other stages can benefit from a degree of interactivity and so is not the polar opposite to exploration in the cube. Emphasis at this point should be on the transfer of knowledge (MacEachren and Kraak 1997).

Many of these questions must be asked over and over again for policymaking. It appears mapping could potentially have the answer to many of these questions. Here the semiotic rules developed by Bertin could assist he pursuit for insight. In fact Buttenfield and Mark (1991) have attempted to transfer these prescriptions to support dynamic visualization. However, MacEachren and Kraak (1997) warn that cartography does not equal visualization so caution should be used when attempting to transfer these cartographic rules to a visual presentation. This was also

emphasised by Taylor (1991). This is interesting, as it appears to suggest epistemological fissure in terms of knowing about spaces and places.

Table 2.1: Responding to Spatial Questions using Maps

| | EXPLORATION | ANALYSIS | SYNTHESIS | PRESENTATION |
|---------------------------------|---|--|---|---|
| Example questions at each stage | What is the nature of the data set? Which of the data sets reveal patterns related to the current problem studied? What if? | Is there a correlation? What is the best site? What is the shortest route? | What results does the analysis suggest? How different are solutions to a problem? How can multiple results be summarised? | What is? Where is? What belongs together? |

(Adapted from MacEachren, 1994)

2.1.6 A Toolbox of Existing Mapping Techniques

There are a multitude of existing techniques and methods available that could be utilised for representing rural social and economic statistics. Most build⁹ on the concepts outlined Bertin (1967) in his basic theory of graphic construction. He distinguishes between different types of correspondence that can be represented on the two planar dimensions – the diagram, networks, maps, and symbols.

Bertin (1967) demonstrates that variation in the position on any plane can be visually selective, associative, and ordered. Further difference in position can be used to inform readers of quantity. Interestingly many of these components can be visually

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⁹ Perhaps not always knowingly

juxtaposed and nested with each other's structure (e.g. symbols can be used in diagrams, maps can be represented as networks). Retinal variables (see Figure 2.3 and Figure 2.4) can then be used to add additional dimensions to the plane or substitute for an existing map dimension.

According to Bertin (1967) a graphic becomes a geographic 'map' when elements of the geographic component are arranged on the plane in the manner of their observed geographic order on the surface of the earth¹⁰. Interestingly maps can be abstracted to a plane and represented as a network due to the topological properties that can be applied to geographic spaces (and hence can also be represented in a matrix).

Maps are visually useful when the option of reading statistics linked to geographical information sequentially on a one-by-one basis would be difficult or time consuming (e.g. in a large table). Here then a cartographic representation can minimise the amount of geographic information that is lost through the process of display. However the process of mapping information to the spaces on the plane makes spatial relationships become apparent and creates new information because of the relationship between numbers and area (i.e. it shows density).

Bertin (1967) outlined the basic mapping options available for presenting spatial relationships such as density within maps. Comprehensive maps (attempting to show all information at once) can be used but can quickly become illegible because of the amount of information on display. Simplified maps utilise the legend, which means no immediate quantification is possible based on the map alone. Both these types of maps utilise points, lines and areas to assist representation through superimposition upon each spatial unit (according to quantity). Other techniques noted by Bertin include the use of contour maps (based on a continuous surface), using vertical sections (that are layered and slice through the map and show quantity at respective location), value variation (most common in choropleth maps), graduated sizes (that fill each unit in a regular pattern), chart maps (which disregard the boundaries of the units use to count the population data and instead diagrams are used to show information and replace each spatial unit e.g. a bar chart or a pie

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¹⁰ This definition is interesting because the observed order may exist dependent on the experiences of the observer. For an interesting discussion on what constitutes a map and how this can vary between person see Chapter 1.1 in Dodge, M. et al. 2011. *The map reader: Theories of mapping practice and cartographic representation.* John Wiley & Sons.

chart), perspective maps (that allow height to be represented on a two dimension plane), proportional sizes (where the size of the symbol is related to the underlying population), dot maps (where the number of dots in the unit represent the quantity in each unit but are not linked to the exact location within that unit), and graduated sizes in a regular pattern (here density and quantity are represented).

Another option is a cartogram; these relate the divisions of the map, not simply to geographic areas but instead to the quantities of the population in those areas (and this can make them appear unfamiliar). Multiple types of cartogram exist (see Section 2.1.7 for examples and a more detailed discussion). In rural areas cartograms of the population tend to shrink the size of the units used within a map and instead enlarge areas that contain towns and villages with large populations. In other words they act to shrink the spaces between settlements.

Kraak and Ormeling (1996) have reported on many of the main statistical mapping techniques that have become available for research purposes. Adding to this research Slocum (1999) has also catalogued thematic cartography and visualization techniques that exist. These lists are not exhaustive but provide many examples of the options available for representing people and their characteristics in population sparse areas.

In addition to showcasing the five basic design elements for maps (title, legend, source, north arrow, and scale), map inserts, supplementary graphics (such as histograms/pie charts) the application of borders (for separation from text and emphasis) is also discussed as well as the use of position and typography. Guidance is provided by Slocum (1999) who burrows from Bertin to suggest that the logical ordering of hues (dark equates to a high value, lighter equals to low) and the use of standardised data relative to the unit of collection (rather than raw count data) are preferential when creating most choropleth maps. Another issue commented on is the use of breaks within the data and how these need to be justified according to the issue under investigation and linked to the use of hue.

Statistical mapping options are demonstrated that increasingly appear to come from disciplines on the periphery of cartography i.e. graphical design and animated computing). These techniques enable the same rural statistics to be displayed multifaceted ways and can interactively guide the user on a journey through the information presented. Hence they can be used demonstrate alternative spatial

patterns in rural Wales and be used to focus on particular issues. They can encourage new ways of thinking about rural Wales.

For example animation can now be applied to show change over time, compare between scales or unpack components of a variable. Alongside this it is possible to show and link multiple maps (rather than one 'best' map) to highlight the different ways rural statistics can be known. Related to this is the interactive integration of multimedia to aid an understanding of an area or the population associated with a place. Therefore in rural Wales statistics can be represented alongside images, video and audio material that sensitize the user issues difficult to demonstrate using choropleth maps alone.

Spatial statistics (e.g. Bayesian techniques¹¹) and remote sensing methods (e.g. Langford and Unwin 1994) can also be incorporated to add rigor and focus to the representation of rural statistics. The geo-visual elements in the map can be associated with tables, graphs, histograms, stem and leaf, box and scatter plots and scatterplot matrix through statistical/geographic brushing. Similar shapes can be found using a compaction index and other statistical techniques such as spatial autocorrelation can help uncover supplementary information not immediately visible from the visual interface alone (in this case the degree of spatial clustering). The Internet now functions as a mechanism for exchange amongst all these elements and enabling colour graphics to be shared and viewed via portable devices without the associated cost of printing¹².

Similar to Bertin the main mapping options available are described as choropleth mapping, proportional symbol mapping, representation as a continuous surface (interpolation, pycnophylactic approaches), dot maps (differentiating true and conceptual points) and the use of pictographics and glyphs (problems with overlap can be resolved by interactive zooming, generalisation and the use of transparency), dasymetric maps (to produce areas of uniformity), multivariate mapping (including multi-mapping), framed rectangle symbols (alternative to choropleth map),

¹¹ Bayes theorem in its most simple form is an algebraic expression with three known variables and one that is unknown. It is concerned with conditional probability in that it supports a hypothesis being true if some event has happened. This theory is unique in relation to other forms of statistics as it actually relies upon an element of subjective judgement in order to determine a 'Bayesian Prior' (a likelihood of something happening based on experience). In this sense increasing the amount of prior evidence is assumed to wash out the degree of subjectivity in reasoning.

12 There is still a cost associated with purchasing the viewing device.

cartograms, flow maps, and the use of the x, y and z dimension (perspective) with time to represent and animate the third dimension, sound mapping and virtual reality in which touch and gestures increasingly become associated with a change in representation.

A historic catalogue of scientific visualization techniques for social and economic statistics has also been developed by Orford et al. (1999). There are now also many eclectic collections of illustrated examples available online (http://www.datavis.ca/milestones/) but have become increasingly difficult to collate because they are so varied and yet interrelated (difficult to distinguish where one technique ends and another begins). Examples have occurred at an accelerated pace, and across a wider range of disciplines. Innovative representations of social and economic statistics in Wales in a policy context are the exception rather than the norm (e.g. Figure 2.8).

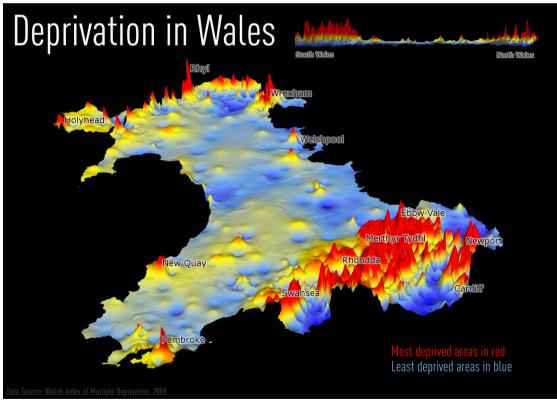


Figure 2.8 Example of an Alternative Representation to Choropleth Mapping

(Rae 2011)

As can be seen there are a multitude of basic options to choose from and yet the bulk of maps that appear in policy reports appear to only utilise a handful of these techniques. This thesis will aim to explore the reasons why there appears to be a reliance on choropleth mapping and explores the consequences of doing so in population sparse areas.

2.1.7 Mapping Issues Associated with Social and Economic Statistics

During the 1990's, computing and scientific visualization combined as part of most desktop GIS software. In addition, increasing amounts of social and economic data was being released for use in public policy. However, it was soon noted that the application of scientific visualization to social and economic data was not a panacea for social and economic issues and was in certain circumstances particularly problematic.

Data relating to dynamic human populations have been suggested to differ greatly in their geographic properties to those relating to the physical world (Martin, 1991). Despite this the location of an individual is normally referenced indirectly to some other spatial object, such as a postcode or household address, or a census data collection unit. People are moored or tethered to stable spatial surrogates, whereas common sense reveals people have varying degrees of mobility. According to Martin (1996), this lack of direct link has far reaching implications. He notes that health, affluence, and political motivations will undoubtedly vary between different localities, but we cannot precisely define the locations of these individuals. Those that make up the chronically ill, the deprived, or the politically militant can be hidden. This then is surely an issue even if maps can be used to display social and economic statistics.

Martin (1996) adopts a somewhat positivist stance by suggesting that attention needs to be directed towards ensuring any data models used are an accurate reflection of the real world phenomenon. Of greater interest to this thesis is the subsequent suggestion that different interest groups may have different conceptions of which phenomenon is important and what is counted as 'acceptable' during this activity. In other words, what passes as a fact in a social or economic map for policy making and why? Different perceptions of what mapping entails could potentially lead to several interest groups having competing forms of evidence for policy purposes. Whose evidence wins through? Is it the power of the model itself to provide the best representation? Or could it be the strength of the collective behind the representation that overrides and ultimately affects the policy decisions made? As part of this research, consideration was given to both the technical aspects as well as the

human element. This was deemed important because for those mapping, in practice, it is as much a technical exercise as it is an exploration of knowledge or a presentation of an ideal.

As small area mapping of digital social and economic statistics is a relatively recent, but increasing, phenomena in decision making, it is perhaps important to consider two important technical issues known within the academic community for some time (Gehlke and Biehl 1934; Robinson 1950; Blalock 1964; Hannan 1971; Clark and Avery, 1976; Openshaw, 1977), the ecological fallacy and the modifiable areal unit problem. Both concepts are very much associated with quantitative methods and ideas of causality. If those in practice are working with quantitative methods then best they work with them appropriately as knowledge of these concepts can aid both construction and interpretation of statistical maps and mitigate against meaningless or misleading representations of the data (Martin, 1996). Both then are particularly important concepts for quantitative study of social and economic phenomena that have unique distributional characteristics that often vary in both locational and attribute dimensions. There are other principles that apply to GIS output (e.g. see (Tufte 2001; Bertin 2010)) but these are the two main initial issues that frequently arise when seeking to produce map representations of social and economic data in areal form (Martin, 1996). Both appear particularly important in terms of the practice of representing and interpreting statistics for rural Wales.

Gehlke and Biehl (1934) were one of the first to realise the issues in rural areas. They noted data from areal units should be treated with caution. They noted the size of unit was a factor. Kendall and Yule (1950) furthered the investigation using UK agricultural data organised into county level areal units. They pose the question that, although they are able to identify relationships between variables, these relationships may not still exist in the same manner when the areal divisions chosen were changed.

In the UK, data describing the characteristics of individual persons and households (such as the census) is only released in an aggregate form for what are essentially arbitrary geographical areas. The areal units have no natural or meaningful geographical identity. Openshaw (1984) states that this fact means that results can be biased. This problem is particularly important for practitioners working with social and economic data in rural areas. Using this type of evidence means either directly or indirectly, making assumptions about the characteristics of individual households

and how they are related to others based on tables produced with areal units that have been subjectively chosen (Openshaw, 1984). Failure to acknowledge this issue means that people can use whatever areal units are most convenient to them without any concern for the underlying spatial aggregation problems. This could be problematic as it means that maps can be manipulated for the purpose of propaganda based on this knowledge and expertise to manipulate boundaries.

Each term is described below from a quantitative methods perspective. If in practice interviewees were using quantitative methods then best these known issues be considered. Basically, if you buy in to statistical mapping you should at least be aware of its rules. GIS has created increasingly data rich and multi-domain settings but also theory poor and hypothesis-free, environments.

Ecological Fallacy

A fallacy is an error of logic usual based on mistaken assumptions. According to Martin (1996) the ecological fallacy is an error of deduction and based on the affect of aggregation. He explains that it lies in the fact that there are many possible aggregation strategies for a set of individual data. As a consequence, relationships observed at a particular level of aggregation (say a LA) may not necessarily hold for the individual observations ¹³. Therefore you cannot make deductions about individuals solely based on the analysis of group data. For example, if we take a hypothetical LA and find that this jurisdiction has average income rates equal to the national average, it does not follow that all individuals will have an average income. In fact not one person may have the average income level and only when combined together would reach this level. It is also true that a correlation between characteristics (high employment and good fitness levels) in a given zone does not necessarily transfer to the individual level. Not all employed people will have good fitness levels.

This is not limited to transferring characteristics of people from one unit (e.g. individual people) to another (e.g. census zones) and may occur when smaller units

¹³ There is also a reverse fallacy called the exception fallacy where assumptions about the individual are transferred to the group, commonly known as stereotyping. Just because people live in rural Wales does not mean they are alike.

(e.g. wards) are aggregated to larger units (e.g. LA). Basically, as the aggregation scheme changes so too does the effect of other influential but unknown factors. In addition, according to probability theory, larger aggregations will have these unknown factors cancelled out. This leads to more stable observations quite apart from the genuine relationships between the variables under study (Martin, 1996).

Basically, for mapping, quite a lot of internal differentiation may take place within a boundary that does not necessarily coincide with what is shown for that unit. The map units may provide a false impression of the circumstances. In this respect, maps can fail to represent underlying spatial patterns because of imposed boundary aggregations that are beyond the control of the map maker. Most boundaries use to delimit rural territory are often inadequate in displaying the location of settlements and misrepresent where social and economic data is collected. Nevertheless, these larger boundaries may unintentionally be a more appropriate representation of the extent of social and economic activities. Their failure to quantify the exact location of settlements indirectly might make them better for representing social and economic issues.

The severity of the ecological fallacy depends on the exact nature of the aggregation being studied which leads to the next interlaced concept: the modifiable areal unit problem.

Modifiable Areal Unit Problem (MAUP)

The original term, the MAUP, was first used by Openshaw and Taylor (1979), and has been investigated by many authors in geography and other social sciences since For example Openshaw (1984) and Fotheringham and Wong (1991). Early studies evidenced its existence while later studies attempted to mitigate its effects (Langford and Unwin 1994; Fisher and Langford 1995).

When spatial data are aggregated, results are dependent upon the spatial scale at which they are conducted, and the arrangement of the areal units employed to represent the data. Such uncertainty means that the results of spatial data where the MAUP has not been considered explicitly should be treated with caution (Manley 2014).

The key difficulty here is that there are a multitude of possible spatial units that may be defined and none has any intrinsic meaning in relation to the underlying distribution of the population. This is true even with the imposition of size and contiguity constraints (Martin, 1996). Therefore, even if an areal unit is modified so that each captures an equal population, that fact that this could be redesigned and result in a different collection of units logically demonstrates that a direct link between units and the underlying population does not exist. The units are human constructs and hence they are modifiable.

Martin (1996) describes how there are two main problems linked to the MAUP known as a scale problem and an aggregation problem:

- 1) The scale problem relates to how many zones to use. More zones tend to equate to smaller units in general. For example, the difference between LAs and wards in Wales. When data are averaged or summed to larger units, a 'smoothing' effect occurs leading to reduced variance between units. As the level of aggregation increases, correlation coefficients increase (Fotheringham and Wong 1991).
- 2) The aggregation (or zoning) problem relates to which zoning scheme should be chosen at each level of aggregation. Basically, where the line is drawn for a boundary. For example, how should the outline of a ward split collections of households or how should the extent of 'rural' be defined?

On the next page Figure 2.9 provides an illustrated example of the MAUP. Given a total population an unemployment rate can be calculated for each square. If the left most collection of sixteen squares A) represents unemployment rates. When the scale is increased such as in B) the rates are smoothed out (now the highest rate is 21%) yet the data is the same only the amount of units has reduced to four. This is an example of the scale problem. The zoning problem is shown in C) as there are still four units but where the lines are drawn can really make a difference.

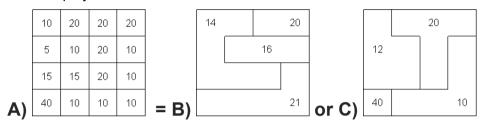
Figure 2.9 An Illustrated Example of the MAUP

Total Population

| 100 | 200 | 400 | 100 |
|-----|-----|-----|-----|
| 200 | 300 | 500 | 100 |
| 400 | 200 | 100 | 100 |
| 300 | 100 | 200 | 100 |



Unemployment Rate



In Wales the units are grouped to give rural definitions for policy (as rural Wales is not homogenous in space). In addition units used to delineate population sparse areas tend to be larger than places where the population is dense and more uniform (to keep the population base comparable).

The problem, according to Martin (1996), is that once a data transformation has taken place in both the ecological fallacy and the MAUP there is no way that the characteristics of individuals (for example the location of the household¹⁴) can be retrieved from the data. Therefore, the aggregation of point data to larger units cannot be undone without returning to the original data - data that are often not publicly available due to disclosure issues. The main problem then with the MAUP is that apparent patterns in mapped areal data may just as much be the result of the zoning system chosen for the data as the underlying distribution of the mapped phenomenon itself.

In some regards the MAUP is an insolvable problem, but it can be mitigated to some extent and many have attempted to do so. Sophisticated statistical techniques,

¹⁴ If taken to the extreme, the household itself suffers from the ecological fallacy and the MAUP.

usually involving Bayesian models¹⁵, can be used to smooth the underlying risk estimates because the data are typically sparse. However, questions have been raised about the performance of these models for recovering the "true" risk surface, about the influence of the prior structure specified, and about the amount of smoothing of the risks that is actually performed (Richardson et al. 2004).

Other solutions include two-step floating catchment models (Langford and Higgs 2006; Higgs and Langford 2013) and geographically weighted regression (Brunsdon et al. 1996; Fotheringham et al. 2003; Dykes and Brunsdon 2007). Multi level models can be used to explore variance at each level of spatial nesting and are more readily utilised given the advances in computing power and advanced algorithms.

Both the MAUP and the ecological fallacy are particularly important in terms of representing rural areas in practice using GIS and both have consequences in terms of rural definition. These technical factors can be manipulated or ignored and result in misleading representations.

2.1.8 Cartograms to Explore Social and Economic Statistics

Given all the inherent problems with social and economic GI, the reader may well be forgiven for asking the question – so why bother? Today the physical geography of the world has more or less been mapped. The natural environment has remained relatively unchanged over time; however, people's perceptions of these relatively fixed items are constantly changing; moreover, maps when applied to humans (that are not necessarily fixed in one place) have proved more difficult to capture and still worthy of further consideration.

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¹⁵ Bayesian statistics offer an alternative to Fisher's frequency approach that still exists today. The frequentist approach ignores human error and instead reports on error within the experiment. However if the error is contained within the experiment then no matter how many times something is measured with a biased instrument the focus will always be on the wrong target. In an era of 'Big Data' there is a risk of increasingly finding false positive findings within population studies as well as losing the signal of what is important within the noise of superfluous information.

Dorling (2012) has outlined how understanding millions of human beings cooperate, compete and coordinate is hard to grasp, let alone how they then interact with other objects, species and resources. He suggests that these complex problems require visual thinking to gain insight.

For the last three decades he has provided a variety of example solutions for accessing these problems by adopting a visual 'human cartography'. Since the early 1990s he has provided a multitude of illustrative examples emphasizing how little is known about large numbers of people. In doing so he explored the application of maps as thinking tools for the study of social and economic characteristics of society. A radical suggestion is made that to show the spatial structure of society the conventional use of maps of physical geography needs to be rejected. This is because traditional maps were not designed to show the spatial distributions of people and, therefore, struggle to illustrate the simplest human geography of population (Dorling 1991).

Dorling (2012) explains, "People are but points on the conventional map, clustered into collections of points called homes, into groups of points known as villages or cities. Communities of people are not like fields of crops. The paths through space, which they follow, are not long wide rivers of water, and yet, to see anything on maps of people they must be shown as such.

Conventional maps cannot show how many people live in small areas; instead they show how little land supports so many people. They cannot show who the people are, what they do, where they go. They show no temporal distribution; they do not need to — how quickly do rivers move or mountains shrink on a human timescale? They will not be an appropriate base to show the distributions of people changing — international migration, moving house, or just people going to work".

(Dorling 2012, p. xxxviii)

He follows by warning that convention in the statistical treatment of these problems can cause important detail to be destroyed, the detail that is of interest. Vast amounts of information can be reduced to but a few. This he suggested was unnecessary oversimplification, particularly as the additional spatial dimensions afforded in new technology make all this information available, in gestalt, in an instant. This enables new perspectives to be gained on the relationship between places, spaces and time.

Dorling promotes the use of cartograms and has suggested "for visualizing the spatial distribution of social structure there is no alternative, if we wish to see the detail of substance". This was because cartograms were perceived to do more than see through the data, they can see into it. This is deemed to provide deeper insight into social and economic problems.

Cartograms are maps in which the particular distortion is made explicit. Population cartograms are constructed so that areas representing places on the paper or screen are in proportion to a specific aspect of those places. This is usually achieved through an iterative transformation of the conventional Euclidean geometry of the area, slowly stretching some parts, while squashing others, until the places' sizes are in proportion to their populations, instead of being in proportion to their land area (Dorling, 2012). The result is an unfamiliar map reminiscent of ancient hand drawn maps. A comparison of a choropleth map with a cartogram is outlined in Figure 2.10. The conventional map (left) and cartogram (right), both represent the same underlying unemployment data. Notice how the shape of Wales is massively distorted and almost becomes unrecognisable.

The Concentration of Unemployment by Ward (1981)

1%
3%
6%
10%
30%

Figure 2.10: UK Cartogram of Unemployment Statistics

(Dorling 1991)

A number of conditions can be imposed on the cartogram for them to adhere to the conventions of traditional maps, for example, the topology of space can be preserved; the maintenance of shape boundaries, or relative compass directions. The aim is to create a topologically and geometrically correct contiguous area maps. Despite these attempts to adhere to what we have become accustomed to, cartograms still look odd. As cartograms could be perceived as unfamiliar objects, it could easily result in them being dismissed. However, according to Dorling (2012), we do not learn through familiarity. He predicts that as they become easier to deploy and better understood in general they would gain in popularity.

Now population cartograms provide an interesting juncture from a choropleth map of the population in terms of rural statistics. This is because through closer inspection of Figure 2.10 it can be seen how the rural UK shrinks at the expense of urban areas. Any advocate for showing rural issues on a map would likely reject this view.

Even closer inspection reveals the enlargement of certain areas from within these rural places (this is clearer in the example shown in Figure 2.11). This alternative view suggests that there is more to rural statistics than first meets the eye when using conventional maps. It is another view of the same data. The question remains in terms of if the unit at which these data were collected was wrong in the first instance. Therefore the Dorling solution to which aggregation to use (MAUP) can be avoided by studying data at the finest level of spatial resolution (however this would require access to private personal information, often collected but rarely made public because of complex legal access issues). However it can be clearly seen that problems exist even using these cartograms.

Openshaw and Alvanides (2001) suggest weaknesses in the Dorling approach and suggest that the MAUP still persist even in cartograms. He highlights certain problems despite acknowledging their usefulness:

Table 2.2: Technical Critiques of Population Cartograms

"There needs to be many rather than a single equal population cartogram"

"There are MAUP effects present in the base data"

"Dorling's cartogram is based on the finest available data (wards in the UK) and are dependent on the number and average size of these base areas"

"It is still a 'show everything as is' technology but what is shown is in fact grossly distorted by the cartogram transformation"

"It is based on the Tufte (1990) assumption that '...the human eye and brain excel in their ability to see patterns, and the more detailed a picture is, the more visible is the pattern' (p.xv), however, this works best when the patterns are simple".

(Openshaw and Alvanides 2001)

Cartograms can however take on many forms, just as the traditional map could have many projections. There are numerous cartogram techniques available and they can be combined with numerous spatial variables, such as in Figure 2.10 - 2.11. Below a cartogram is used to represent spatial datasets gathered specifically for Wales.

A classification of Welsh Middle Layer Super Output Areas using social attitudes data from the Living in Wales survey 2004-07
Scott Orford & Sam Jones, WISERD, Cardiff University, orfords@cardiff acuk

Neighbourhood Attitudes
1 Friendly neighbours and a strong sense of belonging
2 Valleys
3 Attitudes towards neighbours hypical for Wales
4 Mored attitudes, generally less neighbourly, poor sense of community
5 Least neighbourly, poor sense of community
5 Loss neighbourly, poor sense of community
6 University of the Community
7 Source: Living in Wales survey 2004-07
Weigh Assembly Government
(C) Journal of Maps, 2010

Figure 2.11: Cartogram of Neighbourhood Attitudes in Wales

(Orford and Jones 2010)

This representation shows that there are multiple ways that rural Wales can be represented even using the same technique. By manipulating the underlying data both the content shown in boundaries can change as well as they way that boundary is represented.

Slingsby et al. (2010) have also shown how cartograms can be used to abstract large quantities of spatial information and not necessarily be reliant on the map form and instead use labeled rectangular hierarchical structures (Figure 2.12). These types of cartograms can also be used to act as information graphics to supplement existing maps through the process of dynamic linking. This may be where the potential lies for understanding rural statistics. However, the use of these tools is explorative and as such requires a level of skill to operate and understand - fine for a specialist, not so useable for those with limited experience.

Hierarchical Rectangular Cartogram of OAC by GB Unit Postcode

Singuby, Wood & Dyluss
City University London
http://giometre.org/
The Clade for Carbon Williams Cort in the Control of the the Co

Figure 2.12: Cartograms or Infographics?

(Slingsby, Dykes, and Wood, 2010)

Figure 2.12 shows an area classification for each unit postcode. Notice how the importance of geography is starting to diminish. It becomes more about quick access to the information of interest.

More recent approaches have been developed based on the concept of geovisualization, linking data in imaginative ways, and using abstract features (Singleton and Longley 2009; Andrienko et al. 2010; Brewer and Buttenfield 2010; Lloyd and Dykes 2011; Slingsby et al. 2011; Wood et al. 2012; Andrienko et al. 2014; Beecham et al. 2014; Kachkaev et al. 2014; Wood et al. 2014). These approaches have infused a new dynamism and incorporate multimedia, there appears to be another wave of geovisualization on the horizon.

2.1.9 Exploring the Population Census

According to Sieber (2006), most information used in policy making whether with regards to crime; land-use planning; environmental health; habitat conservation or social service provision, contains a spatial element (e.g. address, postcode, latitude and longitude). Geovisualization then could hold the key to extending the use of spatial information to all relevant stakeholders, which would presumably result in better policy making. Due to the spatial aspect inherent in most type of policy making, the study of the field of geovisualization seems most appropriate for this research. After all, according to Dykes et al. (2005), geovisualization brings together the fields of visualization as it,

"draws upon approaches from many disciplines, including cartography, Scientific Visualization, Image Analysis, Information Visualization, Exploratory Data Analysis (EDA), and GIScience to provide theory, methods and tools for the visual exploration, analysis, synthesis and presentation of data that contain geographic information."

(Dykes et al. 2005, p. 4)

Dykes and Unwin (1998) explain how all types of spatial graphics that have been produced would benefit from some attention to the various principles of map design that have been assembled by map makers (cartographers). Unlike their counterparts they suggest that failure to do so can result in representations that are terrifyingly complex or a poor representation of what the data is meant to reveal. Therefore, it seems there is difference in opinion in how to apply visual tools to problems.

The authors follow by explaining the continuing infatuation with the 'one perfect map' and use this principle to explain some of the principle problems with visualizing census data. They put forward an alternative notion to the one perfect map and this is that if patterns keep revealing themselves within map data through multiple views of the data they are more likely to have a 'real' effect. For example, when mapping census data using traditional choropleth maps, the result is often a faithful reflection of the data used, but it can be a poor representation of the underlying pattern it presents (particularly when comparing rural unit boundaries with urban).

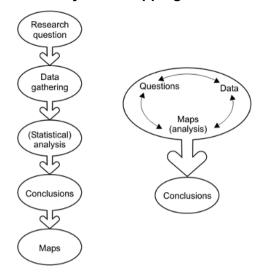
Dykes and Unwin (1998) liken the process of representing choropleth mapping to histograms. They suggest that the spatial boundaries in the map are similar to a histograms bin ranges but with the additional problem of being unequally sized. The main issues are related and shown in Table 2.3.

Table 2.3: Issues with Choropleth Mapping

| Number | Area | Symbolisation |
|-------------------------------|------------------------------|------------------------------|
| Areas with the highest | The resultant map dependent | How the data is classified |
| numbers can often be | on the zones employed; their | and coloured, and the |
| smallest in area; larger map | size and shape as much as it | symbols used, can |
| zones contain more | is the phenomenon under | dramatically change the look |
| population unless the area is | investigation. | of a map. |
| population sparse and then | | |
| the population is made | | |
| similar by the using the size | | |
| and shape of the unit for | | |
| comparison. | | |
| | | |

Dykes and Unwin (1998) suggest using dynamic mapping tools and cartographic data visualization as a means of unlocking the shackles of the previously mentioned issues. They can be used as tools to stress confidence in patterns through the extent they can influence the changes in representation. If a pattern persists during the manipulation of the components, it is more likely to be worthy of note. Hence in Figure 2.13 mapping processes on the right are valued.

Figure 2.13: Linear and Cyclical Mapping Processes



(O'Sullivan and Unwin 2003)

Building on this, and in a UK context, Jason Dykes' cdv (screenshot shown in Figure 2.14) is a cartographic data visualizer, which can function as demonstration software for learning. It uses established symbolism techniques for displaying spatially referenced information and adds newer dynamic capabilities that are suitable for exploratory spatial data analysis (ESDA).

The software is built using Tcl/Tk language. It enables the user to run scripts to produce concurrent linked views of enumerated datasets. Views are available for statistical as well as geographic visualization of univariate, bivariate, and multivariate distributions. These include dot plots (Figure 2.14, third column, top); scatter plots (Figure 2.14, fourth column); polygon maps (Figure 2.14, second column, top); population cartograms (Figure 2.14, third column, bottom), and parallel coordinate plots (Figure 2.14, second column, bottom). Each view is highly dynamic so that transient displays can be produced to highlight specific cases and to focus on points of interest to suit the end user's needs (Dykes 1998). This software was free and accessible on the Internet. It has the potential for being used with rural data to inform policy makers.

Licicater Census Sargie: # Cogds

V59-13 4303
V59-0 050305
V59-0 05030

Figure 2.14: Advanced Human Computer Interfaces - CDV

(Dykes 1998)

Tools such as cdv could prove increasingly important in the emerging era of big data, informatics and predictive analytics. Yet data alone can be overwhelming and so too can these software systems to the novice user. Therefore these tools could assist policymakers articulate and gain insights drawn from data, however, there is no support networks to help when these tools breakdown and become confusing. Moreover, the rise of open data is enabling those outside of government to create informative and visually arresting representations of public information. Any free tools to assist this process can be used to support decision-making by those inside or outside governing institutions. However amongst all this development rural statistics remain confined within existing spatial units.

Tools such as cdv are becoming increasingly accessible within networked environments, and begin to overlap with the visual functions found in a GIS.

2.1.10 Distributed GIS

The term distributed GIS is a 'catch all' term to refer to systems that have emerged within the last ten years. The systems are designed so that the individual components from the software architecture of a desktop GIS are distributed on a LAN or via the Internet.

Distributed GIS represent significant progress from traditional desktop GIS. It evolved from mainframe GIS¹⁶ to desktop GIS¹⁷ and, subsequently, to distributed GIS, which includes Internet GIS (currently Web-based GIS for the majority) and mobile GIS. Distributed GIS relates to GIS programs working on the Internet (Internet GIS) or wireless network environments (mobile GIS). Distributed GIS was made possible by recent developments in the Internet and wireless communication technologies, namely the rapid expansion of low-cost bandwidth on the Internet; a new generation of Web-enabled personal computers and mobile devices, such as Personal Digital Assistants (PDA) or mobile phones. The mainframe GIS and desktop GIS are traditionally referred to as GISystems. Distributed GIS is referred to as GIServices or distributed GIServices. The term 'services' refers to component services. That is, components with certain functions that can be downloaded and reassembled together to construct larger, more comprehensive services to perform certain tasks (Simão and Gibin 2009).

It is somewhat of a revolution in that it has the potential to move GIS from closed, centralised systems producing static maps to the Internet to open and diffused GIServices. The development of distributed GIS is following the progress of computer technologies and telecommunication networks. Along this path, embedding technologies for Web mapping have changed and so have the capabilities offered. Figure 2.15 summarises this evolution.

Internet GIS is a network-centric GIS technology that uses the Internet and the World Wide Web as a primary means of providing access to the functionality (i.e. analysis tools, mapping capability) of GIS and to the spatial data and other data needed for various GIS applications. It provides users with the capability to work interactively with maps and conduct spatial analysis on the Web. It has many applications in urban planning, e- government and e-business (Peng and Tsou 2003).

The move to a new software architecture and portable devices means that the act of mapping is not confined to the computer laboratory or to the desktop, and permits mapping to take place virtually anywhere you can access the Internet. This means that GIS is now portable and, moreover, the resultant map are also mobile and

¹⁶ Mainframe GIS refers to GIS programs hosted on a mainframe with terminal access.

¹⁷ Desktop GIS refers to either stand-alone programs with no exchange between computers or networked programs within Local-Area Networks (LANs).

available on phones, tablets or laptops. The systems are designed in such a way that logical pathways enable each component to function as a whole, if required, on the client side.

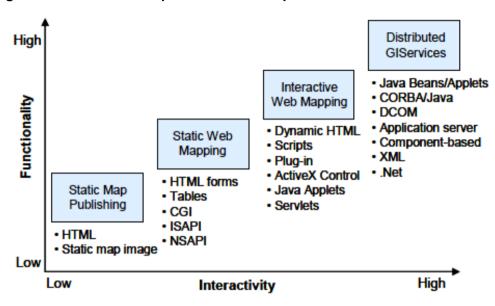


Figure 2.15: The Development of Web Maps

(Simão and Gibin 2009)

Simão and Gibin (2009) summarise the main differences between each development of GIS architecture. The traditional GISystems' architecture is closed, centralised and incorporates interfaces, programs and data (see Figure 2.16). Each element is fixed within the system and cannot be separated from the rest of the architecture. As a result, each system is platform-dependent and application-dependent. This makes interoperability and migration difficult between systems and platforms.

Figure 2.16: GIS Component Architecture

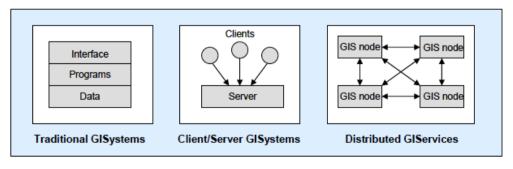


Figure 1 - Three types of GIS architecture.

Desktop GIS are examples that follow the Client/Server architecture (see Figure 2.16). This is what is currently found in most LAs. Each client component can access only one specified server at one time. The software components on client machines and server machines are not interchangeable. Different geographic information servers come with different client-server connection frameworks, which cannot be shared (Simão and Gibin 2009). This means that processes are often locked in to one overall package.

Distributed GIServices are built upon advanced and more sophisticated network architecture. Under a distributed GIService architecture, there is no difference between a client and a server. Every GIS node embeds GIS programs and geodata, and can become a client or a server based on the task at hand. A client is defined as the requester of a service in a network. A server provides a service. A distributed GIService architecture permits dynamic combinations and linkages of geodata objects and GIS programs via networking (Simão and Gibin 2009). The network architecture is akin to Lego™ where different pieces can be bolted together to create a desired outcome.

The move towards distributed GIServices is important to note in terms of this thesis. This is because the visual component can be packaged in isolation as a GIS node. It will still require a data node and processing nodes but can be tailored to the needs of the client. It means that one size does not necessarily now have to fit all.

As new services, standards and protocols are rapidly emerging, and look to continue to do so well in to the future, somewhat of a backlog has developed in theoretical concepts and frameworks. This thesis does not hope to provide the panacea to resolve all these emerging issues; it does, however, aim to rigorously explore specific concepts within these systems that remain relatively stable. As the GIService become more piecemeal, it seems appropriate that the associated theoretical concepts are also treated as such. In the future, it may be possible to demonstrate how these all interlink within a broader theoretical framework but, as such, this is beyond the scope of a solitary thesis that needs to end as technological developments continue to take place (although suggestions will be made later).

2.1.11 Summary

This section has followed the different ways in which mapping has been understood as a technical practice. It has shown that, despite continually edging towards a goal of objective science, the subjectivity of the map maker and those around them will mean that there is an element of art and skill required in all forms of graphic representation.

The ability to now apply computers and geospatial technology to mapping problems has automated many stages of the map-making process and enabled explorative techniques to be applied to spatial problems. The field of scientific visualization developed and became part of cartographic practice. This spawned the subfield of geovisualization within the GISciences that applied the concept of scientific visualization specifically to geographic and problems.

The changing nature of map use was recognized within the map-making community and there was a realisation that maps could be used for visual thinking as well as for visual communication. MacEachren theorized these map uses occurring within a three-dimensional cube that highlighted how maps were used, their audience and the level of human computer interactivity. Therefore, it was becoming clear that maps and human practices were interrelated. Human actions were central to the multiple ways of representing information.

The representation of social and economic statistics within these mapping activities is also not unproblematic. As much as the process of mapping is a human activity so too are the ways in which social and economic information can be understood. These transformations can have just as much influence on how information is portrayed within resulting spatial representations, particularly when the information is appended to geographic boundaries. Many techniques have developed to represent social and economic statistics in an attempt to achieve better correspondence between lived experiences and how they can be understood at a distance. Several of these techniques have become adopted for policy making and planning. However, the ideas and practices of policymaking are changing, as is the technology adopted.

New distributed mapping environments have emerged and are increasingly become cloud-based. These new environments require careful thought when developing new conceptual frameworks of map use.

2.2 Cartographic Critique

"One great dark secret of the history of cartography, barely hinted at in most accounts, is that every map has to emerge from a determinable social and economic milieu. Moreover, the shape of the map will take will largely be formed by the needs, tastes and technical accomplishments of that milieu". (Buisseret, Rural Image).

(Pickles 2004, p. 60)

2.2.1 Introduction

As conceptions of space and the scientific endeavor have developed, so too has how people understood, measured and mapped the world (Dodge et al. 2009). However, as the history of science has taught us, not everyone perceives the world in the same way and people have different ways of knowing about the world. As the section 2.1 has shown, maps have long been thought to epitomise objective, neutral, products of science. As such, the cartographic discipline developed in a way that emphasised accuracy and precision in attempting to recreate the Earth and the objects within it as faithfully as possible. As the previous section has also shown, this resulted in research focussing on theorizing the best way to present spatial data in a map (be that through new devices or though cognitive science to match signs to how people think). Research was channeled via the influence of Arthur Robinson towards 'map effectiveness¹⁸'. Ever since, more and more maps have been produced.

"Even though maps were already ubiquitous in print form, it is now clear to all their users that they have undergone a major shift thanks to the availability of digital technologies".

(November et al. 2010)

Since the mid-1980's, this cartographic epistemology has been under challenge. There have been scientific cartographers seeking to replace the Robinson (1952) model with an approach more rooted in cognitive science or scientific visualization

¹⁸ The systematic profile of map design principles with the map user in mind, leading to maps that capture and portray relevant information in a way that the map reader can analyse and interpret.

principles (as discussed in the previous section). It was realised that maps could function in multiple ways; not just in one-way communicative processes and progress was made in exploring how maps could aid visual thinking and how people interacted with maps both to explore and to communicate.

However, there was a growing group of critical cartographers (drawing on critical social theory) who began to focus on the map as a site of critique and questioned the basic rationale and principles of cartography (Kitchin and Dodge 2007). The problem is that these academics have had little to say about the technical aspects about how maps work or are created (Crampton 2003). This section will focus on the theories of these critical cartographers and the new spaces they open for thinking about maps and how they should be used in practice. The next chapter will then explore the juxtaposition of both theoretical streams within practice, and explore what the outcomes of both these strands of research has meant for people working with maps within organisations. But, for now, this section will begin by reflecting on how people make maps work.

2.2.2 Challenging the Map

To avoid becoming heavy on theoretical terminology and abstract concepts, this chapter will focus on the research paper of Cidell (2008). This paper outlines - using a practical example - how maps can divide opinion when it comes to making spatial decisions. The research explores how airport noise has been modelled and presented within a map (Figure 2.17).

Figure 2.17: Minneapolis- St Paul International Airport noise contour map, 2000



(Cidell 2008)

The map was used to allocate where compensation should occur for residents living close to the airport. The paper showed how conflict was often grounded in the different experiences and knowledge of those measuring airport noise and those who suffer its effects. Cidell (2008) references science and technology studies to show that conflicts between local residents and state officials and/or scientists are in part based on their different types of knowledge about a place, with state-centred scientific knowledge generally considered to override local knowledge (Cidell 2008).

Similarly, this thesis explores those who attempt to measure rural social and economic conditions and how this can be at odds with the direct experiences of those living within them. For example, a rural LA could be labelled as affluent within a statistical report despite many within it living in poverty. Therefore, the concepts within the Cidell (2008) paper could easily be applied to mapping for policymaking.

In the case of the airport, the lines that officially designate airport noise are incompatible with the residential land uses. This causes an issue in terms of where to spend federal funds to mitigate noise. The lines are drawn according to a mathematical model; not from direct observation or measurement (Cidell 2008). Similarly, in this thesis, boundaries and lines have been drawn to quantify social and economic statistics. These lines and boundaries are often incompatible with residential settlement structures but regardless are used in, for example, the classification of rural Wales and the allocation of funding (e.g. WIMD).

Therefore, this paper provides a useful framework for discussing many of the issues related to critical cartography literature. The findings can then be applied to consider the concepts within this thesis. The critical cartography literature does not take the truth of maps for granted and instead considers the political and other subjectivities behind their construction.

There are two major themes that arise:

- 1) The way in which airport neighbours challenge the noise maps (a reflection of the critical literature) and do not take the truths of the maps for granted.
- 2) The conflict between local residents and state officials/scientists are partly based on their different ways of 'knowing' about a place: the local knowledge being overridden by the state-centered scientific knowledge.

(Cidell 2008)

2.2.3 The Mapping Expert?

Harley (1989) brought together the ideas of Michel Foucault and Jacques Derrida to challenge the proposition that mapping could ever be a neutral, objective pursuit. Harley contends that if we can understand where power enters the mapping process it is to the benefit of society.

One way power relations are embedded in maps, according to (Harley 1989) is to consider how maps create rather than merely represent space. Take for example those modelling and mapping the lines of airport noise or those creating a boundary to map social and economic conditions, both create new knowledge. By demarcating a territory, it causes people to fall inside or outside of whatever function it was created to contain.

The process of mapping is not just revealing knowledge because in attempting to do so knowledge is created. Moreover, this knowledge is created according to the rules set out by those who produce them. Knowledge is created through a host of subjective decisions, such as how the map looks; what is included in the map and what the map is seeking to communicate. Through these subjective activities, the resulting maps become the embodiment of prior values and judgments, a reflection

of the culture at that time. They are the product of a privileged and formalised knowledge (Dodge et al. 2009).

Harley argues that since all maps are meant to persuade, they all embody power. This is because the acts of mapping (selection, omission, simplification, classification, the creation of hierarchies, and symbolization) are all inherently rhetorical and power is caught within the rhetoric (Cidell 2008). According to Kitchin and Dodge (2007), this means that maps produce a specific knowledge about the world. Not only are they the product of power, maps can also produce or reinforce power. According to Harley, this means all mapping practice is laden with power as they privilege certain ways of knowing and, in turn, create the expert and the outsider.

Cidell (2008) explores the differences in perspective between mapmakers and map users to highlight how maps are not as scientific and/or objective as they at first appear. The example of the lines representing noise around the airport can be used to exemplify this point. These lines were produced using a model and there is no reason why in the future this model may be shown to be incorrect. Moreover, there is no reason why the way in which noise is shown on the map may also fail the test of time. The point being that the practices that go into the production of the map are part of the culture and the suite of symbols available at that time that go unchallenged because they come from those perceived to be experts. Hence, there is a normalizing and universalizing of culturally specific representational forms (most notably in the UK in the form of the OS map. Or is it now Google Maps?).

In the case of the airport, the scientific knowledge displayed in the maps comes into direct conflict with resident's experiences. The privileged position of the expert has come under challenge from outsiders. In this circumstance, it appears that the residents are not so naïve, and used their experiences of the local area to challenge the mapmakers' orthodoxy. Nevertheless, it remains the case that the experts' knowledge appears to overpower other ways of knowing.

The cartographic literature before Harley tended to position maps as mirrors of nature, whereas Harley presents maps as social constructions; expressions of a power knowledge cycle (Kitchin and Dodge 2007). The work of Harley has been

important as it was able expose maps and mapping to a new critical perspective and opened the floodgates for others to question mapping conventions.

2.2.4 Power and Politics in Maps?

For some, the work of Harley did not go far enough. Regardless of Wood and Fels (1992) and others, it paved the way to follow the enquiry what was perceived to be its logical conclusions. In essence, these authors revealed the political nature of mapping. They showed that eliminating all things bad from mapping was not enough, as the issues could not be circumvented. Instead they could be challenged or counter-mapped.

The literature on public participation and GIS has suggested a way of changing the power dynamic that is to enable members of the community to become cartographers (Craig et al. 2002) but even this can cause power dynamics to arise within groups in the community (Elwood 2002).

Wood and Fels (1992) suggest looking at non-expert cartographers to understand how maps function in terms of specific social interests. This enables the map to be understood not as sending a message but as changing the way other people see the world.

Wood and Fels (1992) asserted that maps work for the state by 'encoding' perceptions of the space within which reality transpires, providing individuals with a means of making sense of the complexity of everyday life that, in turn, shapes behaviour. As such they define cartography as "a form of political discourse concerned with the acquisition and maintenance of power" (Wood and Fels 1992, p. 43).

The state, either directly or indirectly, through its support for major research organisations, is a major producer of maps. In this way, maps represent a particular image of the world that can reveal the intention of the mapmaker, usually reflecting the interested selectivity of the state. In this way, cartography and politics impacted

upon each other. Now this may well be the case to some extent but it seems¹⁹ that Wood and Fels (1992) place too much emphasis within the frame of the map and too little emphasis in the ability of government and people to work outside of the map's frame.

Nevertheless, what this work appears to suggest is that once it is acknowledged that only through maps are boundaries are created, the map can no longer be accepted as representing them. The boundaries are, after all, only inscriptions found within the map. At the same time, however, maps can actually create spaces and places because of the way they present abstract notions in ways that are familiar. Maps create the territory by bringing it into being (Wood and Fels 1992).

Cidell (2008) uses the example of lines representing the noise from an airport to show that, according to the local residents, these lines only have a slight claim on existence from within the map and therefore can be challenged based on the residents experience of noise. Yet, by placing roads and airports on the map (which can be used as reference points as they can be seen and are familiar), it gives credence to the less tangible lines and elements on the map. It makes parts of the map appear accurate and stable whereas this may not necessarily be the case. The airport example is also useful because residents called into question the relationship between the airport and the state and the power relations that may have distorted the mapping and modelling process.

According to Wood and Fels (1992), map making therefore emerged with capitalism and the state. Maps in this way present the accumulated thought and labour of the past. This is known as a repository of "ways of seeing" where maps are made to be both selective and are designed in the interest of the mapmakers (Pickles 2004).

Wood and Fels (1992) suggest that a closer inspection of the role of political and economic factors in determining which 'permanent' features are included as features of interest on a map. Suggesting they act in the interest of the informational economy of the state and also a capitalist economy (e.g. boundary lines, property designators, primary routes, forest cover, campsites). Features of not such central interest are

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¹⁹ Based on personal experiences

classed as impermanent and, hence, excluded from the map despite their relevance in everyday life (e.g. abandoned cars, green or dead trees and shrubs, rubbish, broken bottles) (Pickles 2004). This is interesting as it suggests that information that may be important at a local level may not be shown within maps that serve a national interest. It suggests that maps that are useful for some purposes may be useless in other circumstances. It is about the perspectives (or vantage points) from which they are created.

'The Power of Maps' by Wood and Fels (1992) recommends how maps may be developed and used to serve democratic interests (shown on the left in Table 2.4). Table 2.4 also suggests how recent developments are beginning to enable maps to serve more democratic interests in accordance with these recommendations through technology alone:

Table 2.4: The Power of Maps to Serve Democratic Interests

| Recommendation | Recent developments that may help |
|---|---|
| Map making decentralized and made more accessible to the people who need it. | Distributed GIServices and web mapping could allow local users to access map making and create their own maps. |
| Map makers upfront about their sources, procedures and choices made. | Metadata helps highlight these issues but so too could involving others in the mapping process. |
| Map critics can challenge those 'map-makers maps' and mapmakers who lavish on skill by the way obfuscation. | Open source software and data could help challenge traditional orthodoxy and improve awareness through education and training. |
| The map critic can challenge the arrogance of the expert. | Opportunities might be created through networked environments helping a broader audience understand the GI or lack of it being presented. |

Such questions must be asked again and again as new and different ideological constructions and material interests are asserted under the guise of the natural and objective representation: the map (Pickles 1995). This is because the map resulting from an interested project with specific contexts of production and underlying material interests is always changing.

Both Harley and Wood have helped us to understand how the body of maps are selected, drawn and accepted within a community of users; how some symbol systems are drawn into the domain of cartographic practice while others are not recognised; how the map gets produced; precisely how and under what conditions do particular mapping forms and conventions arise as standards for the social practice of mapping and how these standards and practices get reproduced and normalized as sound cartographic techniques (Pickles 1995). However, Cidell (2008) has shown that maps can be challenged even by those who use them, based on the data that went in; the assumptions, and the omissions made. Local residents were able to challenge by highlighting that illegitimate modeling techniques were used; that personal experiences went against what was depicted in the map and model; that accuracy of the map and its scale were not realistic and, hence, how the map misrepresented information; how the map had the ability to disadvantage some and work from a distance; that it imposed binary logic on fuzzy features and a concern that those outside the local area may accept the map as reality.

These theories and studies are interesting as they highlight that there is a great deal of complexity not only in mapping practice but also within its theoretical underpinnings. It is hard to believe that mapping solely serves the state or those with power because of the agency of those making the maps and those interpreting them. Nevertheless, it is obvious that those in positions of authority have an important role in influencing the look of maps. Moreover the position of the people relative to an organisation gives them the opportunity to actually change the map and not just provide challenge or object to its content.

Maps point to a world that you have to 'buy into' in order to learn and accept (Pickles 2004). In terms of some forms of scientific visualization, less persuasion is needed to buy into to its world, especially when it is being represented as realistically as possible (this 'buy in' can be seen by the crowds of enchanted onlookers at virtual reality stalls in GIS conferences); however, more persuasion may be needed to buy into some of the more abstract concepts such as using cartograms because they present unfamiliar views. This ability to persuade people to buy into a 'way of knowing' - a realism - may also mislead people into a false perception that what is seen should be believed. It is interesting that some of the representations that require the most convincing in terms of their acceptance may hold the potential to

offer a more appropriate way of representing a phenomenon.

Now that maps are becoming less the domain of the expert, and authoritative control is being spread between several decision makers for policymaking, it will be interesting to reflect again on the ways in which maps function. Additional studies have also shown that the binary between local/situated knowledge and universal/scientific knowledge is itself not neat and instead blurry. It has been shown that even local knowledge can be socially constructed as a result of local power struggles. Regardless, Clark and Murdoch (1997) suggest that these knowledge systems can appear as binary when they come into contact during conflict, forcing allegiances to form (Cidell 2008). Therefore, as multiple stakeholders come together for policy making, it will be interesting to consider how these loyalties form and the consequences for the representation of rural statistics; also since work has continued to show how maps can be shown to contain a second text and have the potential to lie or provide selective stories due to the interplay of decisions made during their creation and how they are read by users.

Monmonier (1996), for example, has shown how they can promote certain issues; make certain claims; promote a certain vantage point, and be used for gerrymandering ²⁰ and propaganda. This work has shown that there is also an element of ethics required when using maps. Cosgrove (1999), as another example, has looked at how cartographic imagery shapes and is shaped by cultural assumptions and influences the cartographic imagination while focussing on the performance of map use.

In the 1990's, GIS also came under close scrutiny and most forcefully through the work of Pickles (1995), presented in a book called 'Ground truth'. He situates developments in digital mapping and geographical information systems within transformations of capitalism and the emergence of new 'cyber-empires', and in relation to techniques of war, surveillance and security.

²⁰ Gerrymandering is a practice that attempts to establish an advantage (often politically motivated) for a particular party or group by manipulating the extent of spatial boundaries (e.g. administrative, electorate etc.).

Pickles (1995) argued that the 'positivistic' claims of GIScience were unfounded and claims of a 'god-like' positionality were more a reflection of the value-laden pursuits of the map creators than an omnificent vantage point. Therefore, just because mapping was mediated via a computer did not mean that it had suddenly become more scientific. The power relations inherent in map making remained.

The criticisms thrown towards GIS, like maps, followed three main approaches. The first involves treating the mapping output as a text and question the role of the author in the map's production. The second shows how maps do not just represent space and place, but create them (creating an ongoing feedback loop). The third explores the power dynamics involved in mapping.

These critical literatures were influential even within the more technical disciplines of GISciences and several academics started to take note and show the different ways in which maps work and could be used to challenge traditional cartographic assumptions (e.g. see MacEachren 2.1.5 and Dorling 2.1.7). However, the role of maps in planning had largely remained unchallenged (see Chapter 3). It is only recently (in the last decade) that this has begun to change (Dühr 2007).

2.2.5 GIS and Society

Sheppard (1995) built on several of these theoretical ideas and began to question the role of GIS in society. According to Sheppard (1995), GIS is not simply a tool for processing geographic information. Instead it can be conceived as a social technology, incorporating an entire institutional and intellectual infrastructure that delivers and markets GIS (Sheppard 1995). Was GIS thrust upon policymaking or was the Chorley Report (1987) correct to envisage the benefit? Whatever the answer, the fact remains that GIS is currently being used with social and economic data for policy making in Wales and elsewhere. It has become interwoven within policymaking and provides a focal backdrop upon which numerous decisions are made. However, in adopting GIS, certain practices are reinforced along with certain ways of knowing at the expense of others (Sheppard 1995). This suggests that adopting GIS methodologies as a sole method of analysis runs the risk of suppressing policy options and most importantly people's voices. In Sheppard's opinion, GIS has the potential, in concert with other aspects of our information

society, to systematically influence the course of societal development. Now this may be a bit over the top but GIS can certainly influence where funding and public services are provided. Therefore, it is important to consider where this is the case in rural Wales as part of this thesis.

Sheppard (1995) explores the benefits and limitations of GIS, although notably adhering to a broader structuralism perspective. His work concludes that GIS can reinforce instrumental reasoning and an instrumental rationalism. By doing so, GIS can replace diverse knowledges and norms with a universal yardstick of rationality²¹. This suggests that mapping has the potential to trump other forms of reasoning even though maps may not necessarily be the objective tools their scientific appearance suggests. Maps can be a powerful tool but may be unwisely wielded.

What this means is that the practice of mapping itself can define an issue as highlighted in the following excerpt:

"The capacity of GIS to extend the applicability of instrumental rationality, solving more problems, more quickly in more different ways, entails the risk of simultaneously recasting social issues that do not necessarily fit the problem-solving mode as problems to be solved".

(Sheppard 1995, p. 14)

As the old adage goes 'if all you have is a hammer, all you hit are nails'. Techniques place limits on the types of questions posed and the answers provided. For example, GIS may make it possible to develop sophisticated solutions in terms of where to place a wind farm (Berry et al. 2011) or a nuclear power station (Evans et al. 2004). GIS enables a great deal of information to be brought together and explored in ways that may have not have previously been possible. However, this can detract from the bigger picture in terms of if these forms of energy production are appropriate in the first place or if alternative democratic ways could be found to be sharing the burden of the decision.

In this sense, GIS can narrow scope in terms of what social and economic issues can be investigated. You may be able to study gender using a census but not income

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²¹ Habermas (1984) has referred to this as the colonization of the lifeworld system.

and therefore gender can be more easily incorporated into an analysis of explanatory variables. So too then can the use of GIS because of it prioritises certain topics (that can be easily used within these systems) in social conflicts over others, just because of the nature of the instrument being wielded. More broadly, application of GIS to social and economic issues may in fact detract from other important components to a problem - aspects that are not easily quantifiable. Therefore, GIS is not a neutral tool in achieving predefined ends. It can influence the ends themselves.

Sheppard (1995) suggests that even if technical problems from within GIS can be fixed, it does not follow that the outcomes of GIS use are beneficial. These outcomes may not be premeditated or necessarily make GIS bad. In fact, according to Sheppard, the 'Luddite' solution to abandon them all because of potential problems makes little sense. This is particularly true from the perspective of those with a stake in the technology who may take an active role in their preservation.

2.2.6 Destabilizing Cartography

Pickles (2004) suggests that maps work neither denotatively (shaped by the cartographic representation, labeling, interlinked with other material such as explanatory text, etc.) or connotatively (what the mapper brings to the representation in terms of skills, knowledges, etc.) but as a fusion of the two and concludes that a hermeneutic approach is required. This approach interprets maps as problematic texts, texts that are not authored or read in simple ways (Kitchin and Dodge 2007).

Crampton (2003) argues that many critical cartographers were stuck in the modernist conception of maps as documents, charged with 'confessing' the truth of the landscape (p. 7). He suggests that such a truth is not possible even if the truth lurking behind maps were revealed. Crampton's (2003) solution, to the limitations of both Harley and Wood's strategies is to extend the use of Foucault and to draw on the ideas of Heidegger and other critical cartographers such as Edney (Kitchin and Dodge 2007). He argues that maps should be understood as acting in the world and also being acted on. This moves cartography from its self-reflexive cycles and enables cartography to be examined in its ontological terms (Crampton 2003). Therefore, the taken for granted ontology; the underlying security that the world can be known and measured and upon which all cartography has been based upon, might have been the incorrect starting point.

What has been built from this assumption are a set of what are termed 'ontic knowledges' using scientific techniques that capture and display spatial information and aim to refine and improve how maps are designed and communicate (Kitchin and Dodge 2007). Crampton suggests that instead of looking at cartography from this perspective, the discipline's development should be considered contingent and relational. Wherein, mapping – and truth – is seen as conditional on the social, cultural and technical relations at particular times and places. Maps, from this perspective, are non-teleological historical products operating within 'a certain horizon of possibilities' (Crampton 2003, p. 51). It thus follows that maps created in the present are products of the here-and-now, no better than maps of previous generations, simply different to them.

An upshot of this work is an emphasis on the importance of 'the being of maps' and how they are used to make sense of the world. This suggests that methodologically a study of mapping practice needs to be framed within a particular setting and suggests that the use of methods that are unfamiliar to cartographers may well help to develop theory to guide the performance of mapping.

Kitchin and Dodge (2007) warn that although the map might be seen as diverse, rhetorical, relational, multivocal and having effects in the world by the likes of Harley, Wood, Pickles and Crampton, it remains as a coherent, stable product: a map. In this sense these maps, in Latour (1987) terms, are immutable mobiles (that is, they are stable and transferable forms of knowledge and this allow them to be portable across space and time). Kitchen and Dodge (2007) offer a new perspective. They suggest mapping is ontogenetic in nature.

So does mapping precede the territory it is reported to 'represent', or should it be understood as producing it (Pickles 2004, p. 146)? According to November et al. (2010), many authors have already proposed to deeply revise commonsense ideas on the emergence of territory (e.g. Elden, 2005; Glennie and Thrift, 2009; Paasi, 2003; Painter, 2010). The most recent turn within cartographic theory has been a shift from a representational to post-representational and processual understandings of mapping, with attention focussing primarily on the ontological underpinnings of the cartographic discipline itself (Kitchin and Dodge 2007).

2.2.7 Maps Emerging from Diverse Sets of Practices

Kitchin and Dodge (2007) propose that we should look at the map and mapping in new ways. They state:

"Maps are of-the moment, brought into being through practices (embodied, social, technical), always remade every time they are engaged with; mapping is a process of constant reterritorialization. As such, maps are transitory and fleeting, being contingent, relational and context-dependent. Maps are practices – they are always mappings; spatial practices enacted to solve relational problems (e.g. how best to create a spatial representation, how to understand a spatial distribution, how to get between A and B. and so on)".

(Kitchin and Dodge 2007, p. 335)

In fact this is not unlike someone trying to read old texts (e.g. Shakespeare etc.).

They follow to suggest that the ontological security of the map has sustained because the knowledge underpinning cartography and map use is learned and constantly reaffirmed. A map is never a map with ontological security assumed; it is brought into the world and made to do work through practices such as recognising, interpreting, translating, communicating, and so on. It does not re-present the world or make the world (by shaping how we think about the world), it is a co-constitutive production between inscription, individual and world; a production that is constantly in motion, always seeking to appear ontologically secure.

Kitchen and Dodge (2007) use the concepts of transduction (that understand the unfolding of everyday life as sets of practices that seek to solve ongoing relational problems) and technicity (the power of technologies to help solve those problems) to highlight the unfolding nature of mapping and how it is a processual, emergent endeavor. This offers an interesting way to think about how new forms of mapping can work in an exploratory manner using the coupling of cartographic and statistical knowledge with the technologies and data available at the time. In this way, cartography can be understood as the pursuit of representational solutions (not necessarily pictorial) to solve relational, spatial problems. Importantly, what this does is open a theoretical space in which to examine the technical and ideological aspects of cartography, and the full range of mapping practices including professional cartography, countermappings, participatory mapping, and performative mappings —

all are necessarily selective, contingent and contextual mappings to solve relational, spatial problems.

According to Kitchen and Dodge (2007), such a turn also clearly has epistemological implications with regards cartographic research and work. It means that examining mapping practices can be undertaken in multiple ways (ethnographies, participant observation, technical measurement), as long as they are sensitive to capturing and distilling the unfolding and contextual nature of mapping. It is then possible to observe and acknowledge what cartographers do (undertake contextual science) – not what they say they do (undertake objective science) – and how people bring maps into being to solve relational problems in ways that extend beyond a naïve understanding of map use (i.e. collaboratively, in relation to places and other sources of knowledge, within context, etc.). The outcome of this approach is productive ways of framing and reflexively refining cartographic theory and praxis.

So finally to summarise, it seems that even within the critical cartography literature, different schools of thoughts are present, from those who focus on depicting power and the political and institutional relations of mapping (Harley, 1989; Pickles, 2004) to those more focussed on developing an understanding of maps as emerging through a diverse set of practices (Crampton, 2010; Dodge et al., 2009). Components of each are found throughout this thesis.

2.2.8 A Critical Juncture in Cartography – a Note on UK Issues

Dodge and Perkins (2008) comment on the place of maps in the geography discipline in the UK. They use an example of a 'mundane' location map printed on the back page of the RGS – IBG 2007 Annual International Conference programme to exemplify an interesting moment in the way the geography discipline deploys mapping.

Dodge and Perkins (2008) promote maps to be,

"Visual, immensely appealing, and can be rhetorically powerful, and should, we believe, be at the heart of geographys identity"

(Dodge and Perkins 2008, p. 1273)

However, they use the example of the map on the RGS – IBG 2007 Annual International Conference programme to highlight that geographers are beginning to care little about cartographic quality. They state that the skills of professional cartographers to fashion distinctively powerful and affective images of place are increasingly being disregarded in the search for easier and cost-effective solutions (Dodge and Perkins 2008). It seems that as maps are increasingly being sidelined they are also awarded less time to create.

They state the map producers for the conference could have designed a customized and appropriate location map but instead used a Google Earth mash up²². They suggest that the choice to quickly grab a map off the web is perhaps symptomatic of new forces in the visual representation of space.

Dodge and Perkins (2008) suggest that this is indicative of three wider issues:

- 1) Uncertainty in the role of mapping in the work of geographers in the UK over the last decade.
- 2) Disregard for professional geographic practice.
- 3) A disassociation from new approaches to the visual representation of space and spatial practices (growing in wider social contexts and particularly on the Web).

They highlight how use has declined partly because of the critical cartography literature ensuring the method was rejected or open to suspicion by numerous researchers. They also contrast the situation in the USA which has developed a better institutional context for mapping with more post graduates studying mapping research; readily available cartographic data for the public; collaborative networks and a larger GI industry.

Dodge and Perkins (2008) attribute the decline in the UK to technological change. GIS have 'replaced' the map with spatial analysis offering more powerful a tool than cartographic representation. There is also a parallel with the rising significance of theory in geographical discourse. Alternatives to empiricist and scientific studies have gained ground as increasingly different visual media has been employed. It is interesting to discover if those outside of the geographic discipline are aware of these critiques and may well be using these tools without as much suspicion.

²² A mash up is a collection of digital material drawn from existing sources.

Dodge and Perkins (2008) illustrate the growing issue by comparing the situation in the UK to the 'McDonaldisation' of the food industry. This change to the food industry led to cheap superficially tasty, globally uniform food products, able to generate large profits but with significant social and cultural implications. They follow by explaining that 'Mc-Maps' made with easy-to-use technology, are also cheap to produce and seductive at first glance but can lead to problems. They lack lasting impact; have displaced better alternatives and are low quality. The cheap production methods, accessible desktop mapping tools and new distribution channels, such as the Web, devalue real skills in surveying, compilation, categorisation, and cartographic design.

Dodge and Perkins (2008) explain that publicly accessible cartography is often monopolised by a few online media giants (e.g. Yahoo, Google) that are more concerned with generating a profit from advertising that with map quality. These companies only offer limited web served mapping and have the ability to withdraw or change mapping at will (Zook and Graham 2007). Alternatives exist on the web but are harder to find, more expensive and cater for minority interests.

It seems that although there is a widespread disregard for professional cartography, there is a significant growth in other types of mapping outside the academic community particularly on the web.

Individuals, communities and small organisations are now able to make their own targeted maps, deploying collaborative mapping tools, with a 'mash-up' mode of production and a hacking ethos. In addition, there are a variety of open source mapping projects. This allows the local needs to be less shackled by cartographic images reinforcing the interests of the powerful.

Dodge and Perkins (2008) report,

"If a whole generation is growing up expecting to make and use these maps, shouldn't more geographers be speaking about these issues?"

(Dodge and Perkins 2008, p. 1274)

They suggest future optimism through mapping being incorporated into humanities and social sciences and geographers beginning to change their practice. Suggesting the visual power of mapped sociodemographic data will increasingly play an

important role in the policy making process. They suggest that research is needed into the real world ways in which mapping is deployed and that a dialogue between the technical world of cartography and wider social groups engaged in everyday mapping is required.

2.2.9 Summary

This section has shown how maps, mapping and GIS have all undergone a critical assessment to expose the subjectivity involved in their production and the power inherent within them. The literature has questioned the objects of mapping, those who produce and use maps, and the interests, which these activities serve. In addition, it is apparent that mapping is also an arena for debate and challenge; it is perhaps here where divisions between the expert and outsider are created.

The literature has shown that there is an element of ethics within all forms of mapping as the process can frame how problems are tackled and creates new forms of knowledge. But it appears that perhaps the discipline has been too introverted. Devoting to much attention to the human signatures in the map and failing to also focus on how maps act and are acted upon within daily practices. Research has started to focus on the 'being' of maps and how they are applied to make sense of spatial questions according to the wants and needs of interested actors imbedded in certain contexts. However, this realization has again come at a time of rapid technological change and a growing influx of 'Mc Maps'.

Chapter Summary

This chapter has demonstrated how the technology used for mapping has undergone changes over time. So too have the uses for mapping. Technology and application are very much interlinked. One thing that does not seem to change and that is the underlying method, an attempt to model what is perceived to be around us to tackle spatial problems. However maps and all that they contain are human constructs and as such they reflect peoples interpretation of their surroundings. Increasingly this has been made to appear scientific particularly within GISciences. However the critical cartography literature has exposed maps to be laden with power, control, subjectivity, rhetoric and politics. Maps impose order through artificial inscriptions, simplification, selection and omission and in doing so create hierarchies and define

territories. They can also frame problems. They have also been shown to be transitory and an unstable output of the cultural conditions in which they were created and put to use for a certain purpose.

What is clear is that in light of all these changes, it is important to consider how maps, mapping and geospatial technology have developed not only within but also outside of the cartographic and academic domain. If mapping is part culture, and brought into being as spatial practices enacted to solve relational problems, then how does this take place within organisations? What if those organisations are already linked to planning and politics? How has mapping transitioned into this discipline and what are the consequences in terms of rural visualization?

Introduction

Policy making and planning have communication at their heart; however, little attention has been directed towards cartographic representations used within this process. This is despite maps' communicative capabilities. According to Dühr (2007), in the UK, planning theory hardly touches upon the 'drawing' aspect at all with literature also limited across different countries in Europe. As the previous research then is at best limited, this section will investigate the limited research that does border the subject of map use for decision-making. In this way, this chapter will build on a range of literature that can be utilized to develop a conceptual framework within which to study mapping practices.

This section will begin by highlighting the changing nature of planning theory. Intriguingly, planning theory appears to have been subjected to similar criticisms as those directed towards maps with their claim of objectivity and authority. It is argued here that the map maker has essentially assumed the role of rational planner in a network of communicative actors. It is here where distortion in communicative planning can occur as the representations produced can focus dialogue; shape discourses but also manipulates other participants in the process.

Next, the Chorley Report (1987) will be discussed as this is where the role of GIS and GI for government comes to the fore, instigating a new but familiar role for mapping within a changing technological background. Barriers to the spread and changing nature of geospatial technologies within organisations will be discussed and how this affects the representation of rural statistics for decision making. The section will end by focussing on key aspects from the theoretical investigations into the uses of geospatial technologies within organisations. Additional context about Wales will be provided in later chapters to frame the findings of the research design.

3.1 Changing Theories in Planning - Changing Roles for Maps

Visual representations of complex problems have been called for in planning for some time, mainly due to their ability to understand and powerfully communicate complex spatial relationships. Dühr (2007) describes the work of Otto Neurath²³, a neo-positivist philosopher who, in the 1930's, argued for an internationally understandable sign language for planning. Neurath revealed the uncertainty of knowledge in decision making and argued for better co-operation between different spatial disciplines (including architects, geographers and planners) in order to get the best possible planning and design results. To assist, Neurath attempted to design planning symbols that were coherent, substantively clear and optically effective (e.g. Figure 3.1).

New York

London

Every brick square for 100 square metres
1 sign for 1 man

PICTURE 32

Figure 3.1: Representation of Town Density using ISOTYPES

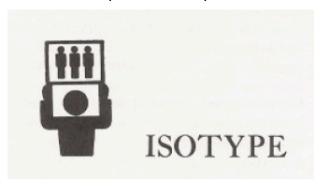
(Neurath 1936, pp. 88-89)

He labeled this the International System Of Typographic Picture Education (ISOTYPE).

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²³ For detail, see Lewi, P. J. 2006. Speaking of graphics. *An Essay on Graphicacy in Science, Technology and Business*.

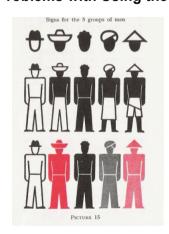
Figure 3.2: The ISOTYPE Brand (Neurath 1936)

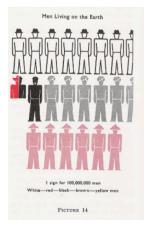


These 'debabelization' methods came to be known as the 'Vienna Method of Pictorial Statistics'. This was an organised attempt to use graphical design for the purpose of achieving changes in society, primarily through visual education of the masses, and especially by presenting basic socio-economic facts in a readily comprehensible form. The aim was to communicate statistics in a visual way, making information accessible to the layperson (Dühr 2007).

Pictorial Statistics were considered to offer a mechanism for including a wider audience in decision making by removing barriers for communication and encouraging the audience to gain their own insight and come to their own conclusions (Faludi 1996 in Dühr 2007). Despite demonstrating democratic values, these works have been questioned because of the way they position the role of planners as 'experts'. In addition, they appear to reflect the values of the authors at that time. Much of the imagery and terminology in this work would not be acceptable today because some of the material would be perceived as racist and sexist.

Figure 3.3: Problems with Using the ISOTYPE Method





(Neurath 1936)

Also note, the use of the colour scheme that was undoubtedly limited by the printing and display technology of that time.

3.1.1 Planning Theory

Changes in planning theory and practice have challenged the role of the planner as an expert. However, a dichotomy between expert and layperson appears to have remained within mapping practices. According to Dühr (2007), there is no particular attention given to the role of cartographic representations in the rational planning theory literature. Dühr (2007) suggests that planners must have assumed 'maps' to be an objective and scientifically informed instrument. If this were the case it would ensure mapping practices remain hidden and unquestioned within planning and policy making. However, as Cidell (2008) suggested (Chapter 2), planners are not likely to be this naïve and perhaps then there are other unconsidered factors.

Healey (1997) proposes that over time the planning tradition became progressive through a mixture of evangelism, formal institutional practice, scientific knowledge and academic development. However, despite existing for well over two hundred years, planning theory only received intensive academic scrutiny post World War II. At this time, arguments began to build up in favour of planning the trajectory of the future.

In order to achieve this goal, the application of scientific knowledge was used alongside an instrumental rationality (Healey 1997). This gave rise to the rational-scientific model of planning within the project of modernity. Typified by utility maximizing individuals, a narrow and 'cold' logic for acting, and competitive or hierarchical organisations. The idea was that impartial reason could be used as a measure of just action (Young 1990). However, as we have seen within the field of cartography, impartial reason is a flawed pursuit particularly if the hope is to create homogeneity in a heterogeneous world.

Nevertheless, planning became procedural and seen as a progressive force that involved, "the clarification of policy goals, systematic analysis, logical generation of policy alternatives, systematic evaluation of these alternatives and monitoring performance" (Allmendinger 2002, p. 54). It purported to separate facts from values. There was a general assumption that the 'best' solution could be determined through scientific approaches undertaken by experts in the field. Top-down and systematic

solutions, however, have been increasingly rejected by many citizens, and are considered to have fostered a general distrust of planners.

The role and scope of the discipline has moved from the control of land use (Cullingworth 1999) to being "charged with coordinating the spatial aspects of a range of policy agendas at the local and regional levels and providing a mediation forum for various interests that is responsive to changing conditions" (Tewdwr-Jones 2008). This resulted in various incarnations in the role of the planner.

Around the time of these criticisms to planning, the role of the map within cartography was undergoing a similar critique with clear theoretical symmetries and overlap. Despite this, there appeared to be limited cross-fertilization and acknowledgement of the literatures between disciplines. Like the map maker, the planner was challenged in terms of their ability to use science or scientific methods to speak a 'truth' and the role of the 'expert' who relies on objectivity. In fact, the criticism of the planner developed within planning theory is reflected almost identically in the criticisms towards maps and map making by critical cartographers. It seems that broader debates in academia and the cultural turn have equally shaped planning and the tools utilized within it.

Table 3.1: Rational, Comprehensive Planning Assumptions:

| In planning (Forester 1984) | In mapping? | |
|--|--|--|
| A well-defined problem | A problem that can be understood using | |
| | spatial concepts | |
| A full array of alternatives to consider | Multiple visual variables and models to | |
| | display spatial distributions | |
| Full baseline information | Selection of appropriate and available GI, | |
| | e.g. topographic layer or Census | |
| Complete information about the | Spatial modeling, statistical tests and | |
| consequences of each alternative | spatial approximations in an attempt to | |
| | mirror facts | |
| Full information about the values and | Assumed or measured through devices, | |
| preferences of citizens | such as social surveys, limited feedback | |
| Adequate time, skill, and resources | Often intensive, requires specific skills | |
| | and technology | |

As can be seen, there are similarities within the processes of planning and mapping; many of which are indistinguishable from one another and often related. It seems to study planning is to study mapping and vice versa. When making comparisons between planning and mapping, it seems that the scientific map maker has in fact become the personification of the traditional planner.

This rational, comprehensive approach to planning has been criticised over several decades because the approach has proven to be unrealistic in practice and could only be applied to simple problems and then only in a modified form. These 'traditional' approaches to planning could not be applied on grand scales. According to Allmendinger (2002), the approach may be helpful as one of many tools that could be adopted, but the approach was not ends to resolving planning issues. This suggests that as part of a wider approach to planning, the rational comprehensive approach as a method would have a use. Hence, for decision making, as a tool, mapping may also have a helpful function but is not an answer in itself. Both the planning and critical cartography literature suggest mapping offers but one of a wider ways of knowing and this is worthy of consideration as mapping becomes increasingly incorporated as an instrument within policy making.

Flaws in this theory in planning caused competing theories to develop. Several are interesting because of the similarities to mapping practices. Take for example the system's view of planning whose main contributors were McLoughlin (1969) and Chadwick and Francisco (1971). The system's approach was influenced by the approaches found in the biological sciences. This view stressed that systems could be found in all areas, not only in the natural environment but also in human society. It was believed that through controlled modification the connections between each part could be manipulated to steer the system²⁴. However, complexity found within systems-based approaches led to arguments that state planning was impossible and undesirable (Allmendinger 2002). Advocates for the system planning approach, however, argued that the systems could be understood if we had enough understanding and computing power. According to McLoughlin (1969), increasing the amount of data and the inputs to projections and forecasts would result in a robust model.

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²⁴ This is essentially what GI network modeling involves in GIS.

Despite the system's approach being labeled as dated and criticised within the literature, it does not mean that we cannot plan or model. According to Allmendinger (2002), rather than discounting it we should simply look at it differently and emphasise a more contextualized approach that realises that aggregate human behaviour is not always reducible to simple formula and that we may never be able to model a region in its entirety despite increased computational power. Healey (1993, p. 240) has more dramatically stated: "Any recourse to scientific knowledge or rational procedures must now be contained within some other conception of democratic acting in the world". This seems to hint that an exhaustive statistical analysis of a region can never be achieved in its entirety and would only be of use when combined with other forms of reasoning. Nevertheless, through the 1970's advocacy planning and choice theory approaches were built on scientific and system's based approaches. These revisions to planning theory argued for taking account of alternative perspectives and offered a choice of scenarios to planning. 'Muddling through' (Lindblom 1959), for example, tackles small bits of a problem in a piecemeal approach and has been incorporated in mixed scanning approaches that offer 'muddling through with direction'. Here, policies are used to guide incremental changes with least disruption to the status quo (Etzioni 1967). Advocacy approaches developed in the 1970's. By the 1990's, it was becoming clear that traditional planning perspectives could no longer flourish in a multi-actor context (Salet and Faludi 2000). So it appears that different theories have gained and lost momentum in academia and practice at different times, culminating in collaborative, pragmatic, and postmodern planning as we approached the end of the twentieth century (Allmendinger and Tewdwr-Jones 2002).

3.1.2 A Framework to Explore Distortions in Multi-actor Decision Making

Planning theory has been discussed in detail and shown to become a collaborative activity but in practice the ideals of communication may not in fact be met. A simple framework for considering how distortions can arise during these problem solving and decision making activities was noted by John Forester. Forester applied Habermasian and ethnographic frameworks with a 'critical-pragmatic' approach to the study of planning practice (Yiftachel and Huxley 2000).

Forester (1984) investigated planning and understood it as a highly practical activity based on solving problems and making things happen. It was recognised that

powerful forces were at work that could result in unfairness in planning practice. Forester argued for a practical and democratic approach that opened up planning to a greater plurality of voices and ways of knowing. For this to take place, it required four conditions of communication to be understood.

Forester argues that in planning the information and communication used, it needs to be clear and comprehensive; sincere and trustworthy; appropriate and legitimate; accurate and true (Dühr, 2007). These conditions were considered essential to help promote informed, discussion without manipulation. This is a useful conceptual framework with which to assess mapping practices. In particular, for social and economic statistics in rural areas, because even if mapping practice were being sincere and trustworthy, there is no guarantee that outcomes would be appropriate, legitimate, accurate or true. This is due to the barriers placed on GI and geospatial technologies and the people who use them. This will be returned to later in the chapter.

Returning to Forester (1984): he starts with a simplistic situation where there is only one agent to consider and they are a utility maximizing, economically rational actor who makes decisions. The setting is the decision maker's office (a closed system); the problem is well-defined (i.e. scope, time horizon, value dimensions, clear and available consequences are readily available. Information here is perfect, complete, accessible, and comprehensible and there are no time constraints. As in practice these ideal conditions can have no guarantee of being fulfilled; Forester concludes that this could result in the presence of misinformation or even manipulation in planning. This rational problem-solving situation becomes gradually deconstructed in terms of 'practical' real world conditions from controlled/uncontrollable and ad hoc/structural distortions (Dühr, 2007). The model presented by Forester is useful as it considers issues that affect the individual personally, as well as through being part of a collective network of interested individuals. It deals with elements of structure and agency.

According to Dühr (2007), the type of misinformation and manipulation has been accounted for in Forester's reformulated model of bounded rationality (see Figure 3.4). This model will be summarised and then reflected upon, in terms of potential consequences for representing social and economic statistics.

Figure 3.4: Distortion in Administrative and Planning Action

Socially Ad-Hoc Socially Systematic / Structural Type I Type II Contingency of Distortion idiosyncratic personal traits imformation inequalities due to Inevitable affecting communication legitimated division of labour Distortions transmission/content losses random noise across oragnization boundaries (cognotive limits) (division of labour) Type IV Type III monopolistic distortion of wilful unresponsiveness Socially exchange interpersonal deception monopolistic creation of Unnecessary needs **Distortions** ideological rationalisation of interpersonal bargaining class or power structure (structural legitimisation) (interpersonal manipulation)

Autonomy of the source of Distortion:

(Adapted from Forester, 1984)

This model is important as it highlights that as GI and maps move and function within and between networks of people (or collectives) that routinely operate within and between organisations, their potential for misuse increases - sometimes intentionally sometimes not. It is here where current practices of rural representation have developed for policy making and planning. Change to law, education, the market, and culture may well help to counter these enduring distortions. Raising awareness of these distortions is an important first step towards any type of change or mitigating strategy.

Dühr (2007) in fact suggested that Forester's model could be used to assess cartographic representations. This model does not, however, pay particular attention to the specifics of mapping for planning and policy making in a UK context. In addition, it contains some pretty dated and idealistic views. Nevertheless, it is a useful heuristic device for understanding issues associated with representing rural statistics in planning and policy making.

3.1.3 The Collaborative Turn and Maps

By the 1990's, communicative forms of planning began to dominate academic discourse due to the multitude of problems revealed in previous approaches and the growing recognition of planning in the plural. The aim was to overcome some of the distortions previously mentioned that manifested in planning practice and discourse by creating an arena for open communication. This has come to be known as the communicative turn in planning theory (Harris 2002).

The theory of Habermas is the backbone to the communicative process with other influences coming from Foucault and Giddens (Allmendinger 2002). This theory assesses three modes of reasoning in terms of the validity claims that each calls upon. These are instrumental-technical, moral, and emotive-aesthetic reasoning. The use of geospatial technology for assessing social and economic GI falls under the umbrella of instrumental-technical reasoning, however critical geographers may argue that changing conceptions of maps and mapping may well cause it to fall into the latter domains. The issue with instrumental-technical approaches is that scientific methods cannot simply produce 'truth' as they are formed by power in society and may well then be used to manipulate (Dühr 2007).

Communicative theory outlines that in the past, planning favoured instrumental-technical reasoning - perhaps due to instrumental rationalism having close links to politics and economics that had dominated public thought. Regardless, this meant that this form of reasoning had overpowered the other two methods that had been labeled outside reason. However, science may not only fail to show truth, it may disguise it. Agreement by those inside planning, in terms of assumptions and theories, may mask problems causing them to remain hidden to the general public. Take maps for example, if maps are considered to display the truth and in fact mask truth then information could be hidden from planners and from the public.

Healey (2006) explains that as the use of values, morals and emotions allow us to make sense of our daily lives; there is a strong reason to give them equally valid

status in decision-making²⁵. But only through reaching agreement where information is equal and all interests are represented can ideal speech (a requirement for communicative planning) occur. As ideal speech is unrealistic, and even more so when maps are involved, it needs to be understood in terms of different forms of knowledges, both expert and local.

Communicative planning has since been interpreted in many ways but has collaboration and multiple ways of knowing at its core. Recent interest has been directed to the role of spatial images in strategic planning at European, regional and sub-regional levels. The theory can be linked with mapping more so than other theories. According to Harris (2002), prior theories had limited reference to the issues of 'place' (Haque 2001) and the importance of geography in public policy matters (Healey 1998). Most theories develop concepts devoid of history, culture or constitutional references; however, collaborative planning incorporates these factors. Therefore, planning and policy making are incorporating concepts of both space and place, where space is a social construct. Places, therefore, are not coterminous with physical spaces and are subject to competing definition by different groups. Therefore, places may have multiple competing meanings applied to them by stakeholders at the same time. Stakeholders are all those who have a particular stake in a place (Healey 1997).

Therefore, collaborative planning is an interesting arena in which people and places' needs are brought together, but also where mapping can be used to represent the needs of these people and places. It is an interesting juncture as mapping may not be designed to or be capable of representing the interests of all those with a stake in these places. Undoubtedly, therefore, there will be winners and losers in place-based mapping actions. This thesis focuses on how existing mapping practices have the potential to evidence social and economic issues in rural Wales. Who are the winners and losers?

According to Harris (2002), an attempt to inject an element of spatial awareness in the communicative approaches to planning theory is one of the defining characteristics of collaborative planning. It involves sharing decision making and information between stakeholders.

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²⁵ Mapping in all its understandings then can become part of communicative planning, especially through its ability to present GI in multiple ways and communicate messages.

There are a number of phases involved in collaborative planning and these include:

- a) Problem setting Stakeholders brought together and become involved and a convener is established.
- b) Direction setting Stakeholders interact to build consensus.
- c) Implementation Stakeholders work to implement through individual and joint actions.

(Margerum 2002)

It is clear that mapping can be utilized within each of these stages; however, the introduction of mapping could alone set the agenda along a specific route and necessitate the further use of mapping for implementation. Therefore, the introduction of mapping needs to be carefully considered, particularly if it is known to have difficulties representing certain people or places. Many new knowledges, skills and competences are required on the part of planners (Harris 2002). The new planner needs to be a knowledge mediator with an understanding of the governance situation; enabling them to draw knowledge resources and work out how to make them available in a digestible way for the dialogical process of policy development (Healey 1997 in Harris 2002). Therefore, it is clear that planners need a new wealth of knowledge and skills before even considering engaging with specific forms of GI and geospatial technologies. However, as will be disused later, the RTPI qualification does not acknowledge the importance of this issue and there is no direct requirement for the development of skills in handling GI using geospatial technologies.

Innes (1998) develops the idea of evidence use within collaborative planning. This requires a new conception of information and of the ways information influences action. Three main points are made:

- Information influences by becoming embedded in understandings, practices and institutions.
- The process of information production and the way this is agreed is crucial.
- Many forms of information count.

Innes (1998, p. 1) states a misconception widely held view of planning before the communicative turn: "The medium is not the message". Following by explaining that the medium of information is actually a crucial part of the message and that simply

being technically correct is not enough to influence action. Therefore, this suggests that even if all the technical issues could be resolved in representing rural statistics, more needs to be done to ensure that this information is used within planning and policy making. Perhaps through improved human computer interfaces, multimedia and networked systems the GI could become more engaging? This could prove important for communicative approaches because it can inspire discussion within key players and help promote the legitimate use of the information between stakeholders. It does, however, involve openness and collaboration.

According to Innes (1998), in communicative planning, information becomes gradually embedded in the understandings of those who are actors in the community, through processes in which participants, including planners, collectively create meanings. Despite the increasing recognition of importance in language and communication in the planning community, there has been a focus on words not images. Dühr (2007) builds on the work of Neuman (2000) and suggests that if communicative planning theory is to reflect the full range of modes and media of communication in planning and society, it needs to address images as well as words.

Planning organisations and planners within them are grappling with a new range of issues; new technologies (such as distributed GIS) and new sets of knowledge (Davoudi et al. 2009). The focus on new types of technical knowledge within planning domains has given Actor Network Theory (ANT) a purchase on planning problems. The details of ANT will be discussed in the methodology sections. ANT seems well matched to understand a world in which technological systems and environmental change are increasing concerns. With its emphasis on the lack of any boundary between society and technology or between the social and the natural worlds, it has the potential to deliver a theory appropriate for contemporary planning practice for sustainability (Rydin 2012). Therefore, social and economic statistics have just as much claim to legitimacy as anything environmental. Arguably, a much needed intervention for rural mapping.

3.1.4 Summary

Despite each theory being more or less popular in time, Allmendinger (2002) suggests that there is no overall linear timeline to planning theory. Planning theory develops in a much more complex manner with theories existing side-by-side and overlapping. In addition, these theories are not universally interpreted, meaning that

the specificities of a particular place will naturally influence the ways planning theories are interpreted and used (Allmendinger 2002). These assumptions indicate that the development of planning theory is chaotic, with different strands of theory becoming incorporated and intertwined at different times and interpreted in different ways in different places. They also involve planners assuming different roles. Perhaps this complexity has led to concepts behind these approaches being practiced within thematic mapping that has continued - and largely unquestioned - within planning and policy making to this day? Perhaps with the advent of Web 2.0 maps, distributed GIS and geodata portals (explained in Chapters 2 and 4), mapping practices will begin to change to align with the multi-actor environments of planning? However, it is also the case that these multi-actor environments may need to incorporate these new technologies and practices. It is partly due to the complexity of these factors that a case study design was chosen as a suitable vehicle for focusing a theoretical lens on critical intersections within these multi-actor processes (this will be discussed in more detail in Chapter 5).

It is clear that in the latter part of the 20th century there has been a realization of failure in the traditional linear models of planning (as too there has been a realization of the one way communication of maps in cartography) where the planner planned, based on expertise which was limited to accredited individuals and collected professionals and organisations (to this extent, this has endured in map making partly due to the barriers keeping maps the domain of the expert). However, it has come to be realised that many different voices across public, private and civil society need to be included in planning and decision making (Rydin, 2012). This is especially true if the most deprived and powerless groups are to benefit from planning outcomes. The multiple lineages of planning theory have helped re-orientate the way planning practices need to be considered in a multi-actor and multi focal policy context.

A new international emphasis has been placed on the relationships and communication between people and organisations and how to manage those relationships and communications (Healey, 2007; Innes and Booher, 2010). With a new era of digital technologies, planning and policy making, this chapter aims to show that a similar view is needed in terms of how maps function in a digital age and can be applied to rural statistics. At the same time, however, others (e.g. Hillier, 2003; Pløger, 2004) have highlighted the enduring nature of conflicts and power

relations within these networks and difficulties in achieving agreement and social goods redistribution.

What this section suggests, when read with the previous chapter, is that technology is changing but so too are the ways in which technology is conceived and used. At the same time, planning and policy making is changing and so too is the way it is understood and applied. Moreover, this has an effect on how tools and technology become applied within these decision making environments. There is a complex and dynamic environment within which mapping activities take place. The question remains as to how the changing nature of planning, policy making and technology affect the representation of rural social and economic statistics.

This section has highlighted competing theories that can be used to understand the role of geospatial technologies and GI in policy and planning. The next section will explore, more specifically, the development of digital GI and geospatial technologies in government. It will outline several core barriers that have emerged which inhibit the role geospatial technologies can play in planning and policy making and led to difficulties in the scientific visualization of rural statistics.

3.2 The Role of GIS in Government - The Chorley Report

The need for an overarching mapping policy has been written about since the Davidson Report in 1938. This report called for nationally homogenous, readily available, and metrically based data (Rhind 1997). At this time the technical issues of making data and maps digital and readily available via the Internet to desktop workstations were not part of the discussion because the technology did not exist.

Since several reports and committees have aligned the paths of the OS and the geospatial technology industry for use in government activities. There was a realization that the government was both a provider and user of geographic information and so all stood to benefit.

The value of GIS for the UK government for handling environmental and other types of geo-referenced data was emphasized in the following statement:

"Indeed it is fundamental to the recommendations in our report, if we are to

get the maximum benefit and save the most money by not having too much wasted effort. Remote sensing and digital mapping are both means of collecting geographical information and handling it by means of digital computers, and we concluded that their development should be complementary". (Select Committee, 1984)

Digital mapping and GI appeared to be in the early processes of becoming enrolled within the domain of politics under the auspice of efficiency and saving the public purse. Not only was the public sector expected to become more efficient the private sector was envisaged to become more competitive²⁶. These promises of efficiency and savings are still echoed today.

The most recognised of these reports is known as the 'Chorley Report' and was published in 1987. The Chorley Report reviewed written evidence often from hundreds of organisations but obtained oral evidence from just over twenty. This was used to advice the Secretary of State for the Environment.

Evidence provided included typical GI applications that were taking place around the time of the report. Illustrative case studies were used here as exemplar studies rather than for explorative academic purposes. They demonstrated the benefits of combining computing and GI combined in practice. In doing so, the studies detailed how GI and GIS could benefit government departments, LAs, land use and rural resource management, utilities and facilities management, vehicle navigation, the private sector, and how it was already being used in the USA (Chorley, 1987). Rather than the showcasing common practices they presented ideal scenarios.

The release of the Chorley Report was regarded as a milestone in the discussion of Geographic Information Systems (GIS) in Britain (Masser 1988). Many of its findings still endure within organisations. As the technology has now spread amongst many organisations, it is important to reflect on the suggestions made within the report. This will help to understand the progress that has been made in each area (see Table 3.2).

²⁶ Interestingly, the third sector was rarely mentioned in the report - perhaps because they were not seen as GI users at the time.

The report suggested that the development of geographic information systems (GIS) was "the biggest step forward in the handling of geographic information since the invention of the map" (Chorley, 1987). Essentially, however, the technology was just reproducing many maps in a digital environment where the cartographer's sweat was being replaced by the technicians' hard drive space and stress.

At the time of the report, the overall uptake of geographic information technology was relatively low. Despite this, the report highlighted three key technological areas to increase uptake:

- The development of spatial databases in digital form to enable quick and easy access to large volumes of data, (e.g. OS topographic information).
- Relational data-base-management technology (that enables the integration of spatially referenced socioeconomic and environmental data drawn from different sources) for manipulation by a variety of users.
- Flexible forms of output produced by computers (in the form of maps, graphs, address lists, and summary statistics, which can be tailored to meet particular kinds of user requirement).

The report predicted rapid developments on all three fronts. Despite this there was an acknowledgement that progress in these was not enough to produce sufficient conditions for rapid uptake. For a rapid take-up to occur, it was necessary to overcome a number of important multifaceted technical and human based barriers to development.

3.2.1 Barriers to the Diffusion of Geospatial Technology in the UK

The most quoted section of the Chorley report was entitled 'Removing the Barriers'. It focussed upon actions needed to enable GIS to be used as a tool to handle GI for government. The report did not seem to consider any other suitable alternative, prioritizing GI use and GIS methods. Table 3.2 provides a synopsis of the barriers. Examples have been added to the table (which are by no means exhaustive) to illustrate how the context for these barriers has now changed. A multitude of recommendations were made, mostly related to these areas. During this period, the majority of barriers to uptake were seen as technical shortcomings. There was a

need to improve the way GI was communicated, integrated, and made available (noting how cost and confidentiality could intervene). However the report also highlighted the human component and how this could lead to cultural or organisational barriers to data sharing. The Chorley report also recommended that a coordinated effort was required as there were a widely dispersed number of departments and organizations with a stake in GI and the associated technology. At the time there was no central body with this responsibility.

The government responded to the Chorley Report and accepted a number of recommendations, but disagreed with the Committee of Enquiry in several fundamental respects. These included the proposed creation, with public money, of a Centre for Geographic Information²⁷. Instead, the government suggested that the GIS community, especially users of it, should form a consortium to take forward the proposed role. There was also limited backing for using the postcode system for the public good (Barr and Masser 2003). The postcode system would remain under license of the Royal Mail. Hence a central, high quality, publicly available set of address data for the country – which is owned by the public, not by private organisations and available to anyone as Open Data for use and re-use, to this date does not exist. As the government withheld open access to certain types of information, it created imbalances between organisations and restricted mapping practices. It also created inefficiencies because state owned postal, surveying, land registry, census and taxation services were all creating address lists based on their own operational requirements.

The Chorley Report did lead to acceleration in the OS's digital mapping program, prompted a Tradable Information Initiative within central government, and generally increased awareness of GIS potential. Many of the original issues found within the Chorley report remained unresolved many years after the publication of the Chorley Report. Heywood (1997) reasoned this was due to the subject matter not being deemed sufficiently important to appear on the political agenda. It was not a vote winner.

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²⁷ This could act as a focal point for common interest groups, review progress, and submit proposals for the development of a national policy.

Table 3.2: Key Barriers Highlighted by the Chorley Report

| Main Barriers | Description | Current example |
|---|---|---|
| Digital Topographic Mapping | A map of the surface of the country to show both natural and man-made features e.g. relief, rivers, settlements, and roads. | Mastermap Web based maps such as Google Earth and the like Imagery and perspective |
| Availability of data | Digitally stored data with a location reference. | PSMAGeodata PortalsVolunteered GI (GPS)Value added datasets |
| Data linking | The infrastructure needed to combine data with a location reference using a common language. | DNFWeb 2.0StandardsMetadataLegislation |
| Awareness | Raising the profile of GIS and the benefits of GI for managing resources, planning and policies. | Chorley Report AGI Academic Institutions Industry and sector related seminars and conferences Google Earth and the like, bringing mapping to the public |
| Education and training | Ensuring sufficient employees with the skills to make use of the data and technology. | Academic licenses Open initiatives e.g. QGIS Academic Qualifications and CPD |
| Research and development | Improving the knowledge base to drive the technology forward. | GISRUK Mainly technology driven but increasingly becoming application orientated and starting to incorporate social theory |
| Coordination and the role of government | Developing a central body responsible for ensuring barriers are removed and action is aligned. | InspireLocation Strategies |

3.2.2 Raising Awareness and Assembling Interested Actors

The recommendations of the committee, coupled with the government's distanced response, prompted the GI community to coordinate themselves²⁸ and establish an independent GI organisation: the Association for Geographic Information (AGI). This result was a healthy, though perhaps inward-looking, community independent of government (Heywood 1997). The AGI is currently still in operation as a multidisciplinary organisation dedicated to the advancement of the use of geographically related information. It covers all interest groups, including local and central government, utilities, academia, system and service vendors, consultancy, and industry. The organisation charges a membership fee.

The Chorley Report prompted significant changes in the UK with regard to GI and geospatial technology. It also encouraged likeminded enthusiasts and experts in the field to form a network to drive geospatial technology in to the future. However, a critical problem remained: how could the fuel for geospatial technologies (i.e. GI) be released for the benefit of the public sector? Undoubtedly, this was an issue that required a collective and coordinated effort to overcome. It required work by those linked to the field to bring the issue to the fore. Moreover, even if this problem could be resolved, there is no guarantee that the GI in the public sector would be adequate to tackle public sector problems.

Since the Chorley Report, multiple groups have formed and reorganised creating a confusing and complex environment for anyone new to the field (see Gilfoyle and Thorpe (2004b) for a detailed anthology). To be clear, it is useful to reflect on the collective effort of these groups to organize the information domain within central and local government and focus on their outputs.

Outcomes of these working groups included the establishment of a digital land and property gazetteer (to log local land and property assets); a National Street Gazetteer and the formation of service level agreements (SLAs) between the OS and local government in 1993 (Gilfoyle and Thorpe 2004b).

In Wales, the DU emerged from within this milieu and has become key to the organisation of data between LAs and meeting the needs of the WG. A coordinated

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²⁸ Contrasts with the top down led approach in the US.

effort also began between the WG, the AGI Cymru, and several local working groups. A result of this effort was a specific action plan for Wales for implementing a GI strategy. This was published in 2003. In addition freedom of information and European polices were beginning to structure how GI and geospatial technology were to be used.

European level coordination was undertaken by EUROGI (the European Umbrella Organization for Geographic Information). The mission of EUROGI was to promote, stimulate, and support the development and use of geographic information and technology throughout the continent (Gilfoyle and Thorpe 2004b). Operational pathways within which GI could be exchanged were beginning to be forged - at a local level, nationally and internationally. However, it became evident that integration was difficult and the levels of skills and expertise varied at all these levels. With increasing awareness of the sector, there was also an increasing awareness of the problems it faced. A critical problem was ensuring appropriate education and training.

3.2.3 Education and Training

At the time of the Chorley report the geospatial technology sector was the domain of a highly specialized and technical collective of enthusiasts. The merge between cartography and GIS for government purposes then required raising awareness of the technology, how it functioned and how it could be applied to a more general audience. It was also realized that even with increased awareness the adoption of the technology would not necessarily ensue. The report recommended tackling this problem through the education and training.

The Chorley Report particularly stated, "it is apparent that there continues to be a serious gap between education and training requirements and actual provision in the geographic handling areas. In our view, this gap is a factor holding back the use of technology for handling spatial data and the shortage of trained personnel could be even more of a constraint in the future as demand increases." The Chorley Report concluded that there was "a need to increase substantially, and at all levels, the provision of trained personnel."

Masser (1988) also suggested a massive education and training programme was required to ensure a rapid uptake of the technology. Just because there was an

acceptance of a new technology, it should not be taken for granted as new working practices were required to perform existing tasks. The technology also offered the prospect of performing quite revolutionary new tasks but only if human capital was invested to go with the technology.

Coupled with the spread of digital GI and geospatial technology within central and local government, there was a dramatic growth in the number of higher educational institutions offering GIS education, either as part of their degree courses or as postgraduate programs (Seremet et al. 2013). A British syllabus was hence developed and he Natural Environment Research Council (NERC) and the Economic and Social Research Council (ESRC) helped establish Regional Research Laboratories (RRLs) who helped create training environments. These RRLs helped to pump prime, trained individuals into the marketplace that would continue the spread of technology use and increase awareness of the benefits of the technology. The Royal Institution of Chartered Surveyors (RICS), the British Computer Society (BCS) and The Association for Geographic Information (AGI) were the other main driving forces for GIS education in the UK.

Seremet et al. (2013) states that one of the key themes in the literature is that students generally enjoy the practical side of GIS and learning about particular techniques. They are less enthusiastic about the GIS theory, which is often taught in lectures. The academics, by contrast, generally believe that GIS should be more than a set of skills and simply learning to press buttons in the right order and because GIS software and skills requirements change so frequently in the workplace, it is important that students understand the general principles and theory. Without the theory, it is easy to overlook misrepresent rural statistics by clicking a few buttons. This situation is therefore an important conundrum to resolve to ensure at least an awareness of some of the issues. There was also the issue that trained individuals did not necessarily end up working for the public sector, many became involved in the commercial side or moved in to the Higher Education sector themselves.

A key milestone was an agreement between the major GIS vendor, the Environmental Systems Research Institute (ESRI) and the Combined Higher Education Software Team (CHEST). Under this agreement, licensed GIS software was offered to all the UK's HEIs at reduced rates. One of the most important results was the establishment of the well-known ArcGIS software suite as the most-widely used software in UK Higher Education. Further important advantages were derived

from the EDINA project, based in the University of Edinburgh. This made it possible for UK departments to easily access licensed digital data through their university server, thus completing an important stage in the development of GIS infrastructure in the UK (Field, 2008). Unfortunately, this agreement was not directly extended to schools.

There had also been some attempt to include GIS in the national school curriculum, although tight competition for funds in schools meant that the practical exposure of pupils to GI technology was limited (Heywood, 1997). In 2008, GIS earned a place within the national curriculum and in Wales it forms part of the ICT requirements of the geography syllabus. Resource restrictions continue to limit the use of GIS in schools.

Despite awareness of the value of GI increasing among technology specialists in the public sector, a long-term agenda remained. This was to increase awareness among managers and high-level decision makers, as well as among students in schools and universities. Effort was also devoted to ensure there were continued professional development opportunities for staff already working in the sector. This was deemed necessary due to the rapid changes happening within the industry at the time. For those who were trained, an argument was also emerging that, as the field of geospatial technology was rapidly changing, education and training should be more than a once in a lifetime event (Muller, 1993).

In 2002, the Association for Geographic Information in conjunction with the Royal Geographical Society has added a new category of certification for GIS professionals to the existing Chartered Geographer status. The CGeog (GIS) is open to both established GIS practitioners and new practitioners who are either graduates or non-graduates. In common with most certification programmes, these require participants to demonstrate a level of continuing professional development throughout their careers to demonstrate that their knowledge and skills remain current.

The focus of education and training still appears to be mainly focussed on the software and technology but perhaps more awareness is needed in terms of the value and theory of geographical information; the fuel for these systems and developing skills that would be capable of transfer between technologies.

3.2.4 Availability of Data

In the early phases of the GIS revolution, the primary concerns were getting the hardware and software to function reliably and speedily (Coppock and Rhind 1991) but since the mid-1990's the primary concern shifted to the information required to use GIS (Rhind 1999). This shift in concern was summarised by England (1995) who suggested, "Do not think of system, think information" (Gilfoyle and Thorpe 2004b). Maybe this should be extended to people, legislation and organisational cultures? These factors appeared to have limited the availability of data.

Clearly when the Chorley Report was written much of the battle was transferring paper records in to a digital format. In this case data availability in most cases in fact meant 'digital' data availability. The OS was in the process of providing a fully digitized topographic map for the UK and had a pricing policy that made its digital products expensive. Other publicly held data was either locked within paper records or held in departmental silos as there was a fear of it being used for competitive advantage. (Heywood 1997).

To increase access to public sector data, the government used the Tradable Information Initiative (TII) as a vehicle to make as much government held information as possible available for the private sector to turn into electronic services. The TII required all government departments to evaluate their information holdings and to charge market price where there was already an established market, and where a market was yet to be developed to charge only for the costs incurred over and above those associated with handling the information for their own purposes (Craglia and Masser 2003). This inadvertently led to the creation of GI catalogues and documentation. This GI documentation has come to be termed metadata. Put simply it is data that describes the GI (its attributes, ownership, date of collection and so on). The aim of creating GI catalogues and documentation was to avoid the patchwork uptake and use of GI and GIS. Chorley (1997) suggests the TII was doomed from the start as incentives were removed for departments to make a profit from their GI (Heywood 1997). The issue of data as a public asset or a commodity for commercial exploitation continues to hinder the availability of GI for exploring rural issues.

In the 1990's, the majority of people working in the public sector had a limited understanding of GI and its potential value, where it could be found, and how it could

be used in practice to assist decision making. There was also a lack of consensus in whether GI should be positioned as either a marketable commodity or a public funded good. Particularly for social and economic statistics a parallel issues of confidentiality and disclosure emerged. This required personal data to be aggregated to some minimum spatial unit for data sharing. This created a subtler barrier to data availability and had consequences in terms of data linking and representation (to be discussed later in the thesis). There appears to be limited understanding of the value of holding data consistently using the highest level of granularity amongst those mapping for policy making purposes.

Over the following years much government data was digitized however many data issues remained unresolved. Data availability was increasingly becoming about the type of data made available and the scale at which it was released. Due to a rather piecemeal development many data collection units were not aligned or consistent, and many social and environmental datasets were not available at an appropriately detailed scale for the analytical capabilities of GIS to be used to its full potential.

Regardless, a national topographic infrastructure was made available at a price. The OS had a full vector and raster map covering the extent of the UK. The base map was enhanced and pricing polices tailored for large users in order to recover production costs. Despite the OS still having a monopoly on the GI market advances in GPS and satellite technology meant alternative sources of GI were rapidly becoming available.

Aside from the difficulties in terms of unifying GI in the UK, another issue existed in the fact that the collection of GI also varied by nation. This made it even more difficult to unify datasets and develop an international data infrastructure. At the time, each country tended develop based on its historic collection legacies (e.g. censuses of the population and inherited frameworks (topographic templates) and what this meant was that each country's policies towards GI varied (Rhind 1999).

Notable differences existed, and still do to some extent, between the UK and USA. In a largely top down approach, the US Federal Government made the distribution of data at a cost at or below dissemination a matter of principle. As such, copyrights are removed from the majority of data held by the Federal Government. Variation in collection still occurred, however, by federal state. Many have suggested that this has created an industry that has paid for itself through taxes but also by improved

decision making through the use of its products leading to substantial national benefits (Thrall and Thrall 1999). The UK, on the other hand, based its policy on charging a market rate and varies by government department/executive agency and more recently to some extent by devolved nation. All government generated information being regarded as crown copyright and its use is licensed (there is potential to set the charge at zero). Executive agencies had delegation for administrating Crown copyright while others adhere to central government directives (Rhind 1999). This resulted in a relatively slow uptake in GI, which varied by organisation.

Recent open data initiatives and a new Public Sector Mapping Agreement (PSMA) have created an influx of GI for public sector use. Despite this, and a common policy on GI, the UK has key differences in GI datasets that vary between nation states e.g. in key measures such as deprivation. This variation appears to have created an uneven release of data and will make it increasingly difficult to link datasets outside of Wales for certain topics in the future.

3.2.5 Data Linking

This topographic infrastructure was the platform upon which other datasets were built and designed. However, at the time of the Chorley Report there was limited awareness or coordination in terms of how new value added datasets were being developed between different public bodies and how the should be integrated. Moreover at the time it was difficult and expensive to store large datasets and methods and statistical techniques for integrating vector and raster datasets were less well developed. In addition the fragmented and uncoordinated development of GI and boundaries made it difficult to link social and economic statistics together for mapping. Human Computer Interfaces were poorly developed making the processes technical and time consuming. At the time World Wide Web and mobile technologies were not available and this made sharing information dependent on writing and reading to disks to transfer digital data and information between organizations. In addition data produced was locked within the software and technologies used to create it. Consequently, many datasets were collected in isolation and were stored incompatible formats for exchange between workstations and lacked coherent standards (Heywood 1997). Social and economic statistics also carried the confidentiality issue that made data linking difficult.

GI, like other forms of digital information, has qualities that differentiate it from other types of traditional resources. For example, it is expandable (i.e. it increases with use; it can be compressed summarized and integrated; it can substitute for other physical resources (e.g. a tour guide); it can be transported almost instantaneously (and travel across the globe); it is diffusive (and accelerates the removal of concealment and control) and it is shareable (Cleveland 1985). These qualities have resulted in policies, laws and practices developing to control the exchange of information.

According to Epstein and McLaughlin (1990), the general goal of law in the areas of access and ownership is to make as much publicly held data available as possible, subject to reservations about personal privacy and commercial value. The problem with GI, as described by Longhorn et al. (2002), is that "Coupling descriptive data to precise location data is the cornerstone of many types of spatial analyses. But when locations are easily linked to identities of individuals or farms there is potential for violating personal privacy". These are fundamental issues in terms of linking social and economic statistics.

Data linking, in terms of social and economic statistics, has proved challenging in several respects. Firstly, the fundamental building blocks for linking social and economic statistics are the individual or the household; however, certain legal issues relating to GI have prohibited sharing information at this level. Therefore, an alternative minimum spatial building block is required for collecting or representing social and economic statistics. The unit postcode was suggested in the Chorley Report and any larger spatial units should be coincident with the structure of underlying geographies.

Postcodes were seen by the Chorley Report as useful because they were sufficiently small to facilitate aggregation to larger areas and, to locally defined areas of interest, they enabled address data to be linked whilst preserving confidentiality (however this is debatable). They were part of a working system that was regularly updated by the Post Office, and that a full coverage of the country was provided (Walford 2002). In practice, the postcode system was also useful for surveying people because most householders can tell you their address and postcode; whereas, they may be pretty hard-pressed to provide you with the grid reference of their household. However when social and economic data is attached to postcodes there was still likelihood that data held would contravene the Data Protection Act (Heywood, 1997). In

addition postcodes can vary in size and shape quite dramatically especially in population sparse areas. They were not designed with the representation of social and economic statistics in mind (whereas larger spatial units such as LSOA have been because they attempt to keep the number of people in each unit similar for statistical comparisons). The full address list linked to a grid reference could however provide the spatial detail for all types of analysis and can remove many of the issues associated with area aggregation found in most existing geographic boundaries.

Postcodes are rarely used to share or present data between organisations; they are mainly used - if at all - as a unit to collect information (especially in government population surveys). If data at a postcode level is released, it tends to happen after postcodes and their addresses have been aggregated to larger spatial areas. The UKSGB²⁹ was developed and linked to the postcode unit. It related postcode geographies to other standard geographies such as Wards, Electoral Constituencies, and LAs. This has since (post 2010) been replaced by a GSS Coding and Naming policy.³⁰ Ownership and pricing made linking address list difficult and confusing. It remains somewhat of a contested issue (most notably between the OS, the Royal Mail and local government).

Following the Chorley Report, several other important outcomes assisted the progression of GI linking between geospatial technologies in central and local government. According to Heywood (1997), these developments included the emergence of metadata standards (catalogues of data about GI), the GI Charter Standard Statement (good practice), and a National Geospatial Data Framework (for data sharing and linking). Therefore, the availability of interoperable GI was slowly becoming established and within a legal and operational framework. Partnerships emerged between the AGI, the LGMB, the OS, the Valuation office, the Land Registry (HMLR), and other national initiatives that aimed to create nationally consistent GI databases. There was an increasing call for 'one-stop shopping' for GI.

The Open GIS Consortium (OGC) was founded in 1994 to address the issues of

²⁹ The UK Standard Geographic Base developed by the ONS was updated by a Standard Names and Codes Database but were different with that of the Communities and Local Government (DCLG) and the Department of Health (DH)

http://www.ons.gov.uk/ons/guide-method/geography/products/names--codes-and-look-ups/index.html

interoperability, data access, standards, and specifications. Through building consensus amongst the wider GI community and establishing a common language, so that discrete GIS software components can communicate with each other, the initiative removed some of the restrictions to the widespread adoption of using specific open interfaces (Gilfoyle and Thorpe 2004b). Open initiatives were being encouraged in the UK to unlock and improve GI, facilitate and encourage data linking and enable the widespread use of geospatial data, which is fit for purpose for government, businesses and citizens (Hadley and Elliott 2001). The availability of open source software assists development especially in conjunction with free licences.

Since the Chorley report GI policies linked to the market and legislation have increasingly acted as barrier. Given their increasing importance and link with data availability and linking these too will be discussed.

3.2.6 Legal Issues Related to GI

Barr (2013) has highlighted the evolution of public sector information polices that limit how GI can be used

| Crown Copyright (17th Century, 1911 Copyright Act) | | | | |
|---|--|--|--|--|
| Rayner Review of Central Statistical Office (1979). | | | | |
| Tradable Information Initiative (1986,1990) | | | | |
| Crown Copyright in the Information Age (1998) | | | | |
| Freedom of Information legislation (2000) | | | | |
| Click Use Licence (2001) | | | | |
| European PSI Legislation | | | | |
| European INSPIRE legislation | | | | |
| Open Government Licence (2010) | | | | |

These rules also form barriers and can shape the resources available for those attempting to map rural statics.

Since the Chorley Report the impact of new technologies had changed the types of things done by data collection/provision organisations and impacted on how they actually did it, and this inadvertently had consequences for their customers. However, within the public sector the distinction between data provider and user was increasingly becoming blurred. This coupled with changing expectations of the public; a shift towards local decision making; instigated in parallel with major reforms in government and governance have, in unison, necessitated the need for new national policies related to GI. The advent of major commercial GI providers and broader European and international trading practices have interlinked these policies within specific broader pieces of legislation (Masser 2011). This has ultimately framed how GI can be put to use in a legal sense.

Rapid changes in technology may instigate the need for legislation but at the same time law can also instigate change (Cho 2005). Clearly then, GI and the geospatial technologies to manage and display this information are locked within a legal framework but at the same time are helping to shape it. This means that legal issues are very much linked with the representation of rural statistics through the role they play to balance the power of the government and the commercial sector and the rights of the public.

The main legal issues that affect the exchange and release of GI and geospatial technologies can be reduced in to several categories: Intellectual Property Rights (which include copyrights); Privacy Issues (that include Freedom of Information and Data Protection); Contract Law (outlining the relationships between provider and user), and Liability Standards (Cho, 2005). As such, these legal issues are there to resolve disputes, maintain order, harmonize expectations, ensure efficiency, protect and ensure equal opportunity. This is done, as stated earlier, amongst existing national government policies, programmes and regulations that can shape the nation's spatial data infrastructure. Sometimes, however, this context can work against the provision of GI and geospatial technologies as a public good³¹.

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³¹ Information is sometimes a public good. In economics, a good is 'public' if its use by one person does not prevent or curtail its use by another. A map is a common form of public good produced by governments at all levels other forms of spatial data produced by governments, e.g. census statistics are also public goods.

The required actions of people in policy-making organisations are in most cases a reaction to a governing framework of policies and procedures set in place to address legal issues. However, the sheer complexity of this legal framework may result in many people unintentionally ignoring certain aspects of this framework due to nothing more than a lack of awareness. Much legislation has been masked within a maze of acronyms and jargon. Initiatives, infrastructures, frameworks, strategies, programmes, conventions, acts, treaties, directives, contracts and so on, can each be set in place at several scales locally and can vary between nation. In addition, some issues can carry more weight or legal clout than others and variable impact different types of organisation dependent on their common practices. Legal issues then may deter managers from the use of GI within organisations, even if the personnel were available who were trained technically in geospatial technologies and how to gain knowledge from GI.

Laws regarding privacy and confidentiality with regards to digital information *protect* individual and commercial aspects of property from excessive government and private power. Seemingly, innocuous records of farm expenditures, farming practices, or property boundaries are legally viewed as personal data, especially under recent European privacy laws. Countries with personal data legislation generally require that administrative steps be taken to inform the person(s) affected of what information is being collected, why, how, and for what use; as well as to register databases holding the personal data. Failure to follow these protective steps can lead to criminal prosecution, as under the UK's Data Protection Acts. The Data Protection Act 1998 requires anyone in the UK who is processing data that identifies an individual to register with the (ICO) as a data controller. The information must be fair, limited, adequate, accurate, up-to-date, legal, secure and kept within the EU. There are special provisions for handling certain categories of sensitive data (Cho, 2005).

In law these are relatively new concepts and therefore may warrant further consideration in terms of their implications for mapping practice. This is because in attempting to protect individuals the laws regarding privacy might put certain members of the population at risk through continuing to mask their individual problems from political agendas. In addition, however, the display of GI in the first instance may have unintentional and unexpected social consequences. A balancing act is therefore struck between public access to information and individual privacy rights but only when publicly held data becomes digital.

The Freedom of Information Act is designed to provide citizens with reasonable access to publicly held records and provide citizens with the basis for understanding government functions and actions that concern them. Complimentary regulation guides what these records are; which become open to general scrutiny and the conditions under which copies can be made of them. It is argued here that maybe this does not go far enough in terms of opening data for use in geospatial technologies and perhaps distracts the public attention away from more important issues caused by the commercialization of GI.

Property Rights, for example, set in place the details of who owns information and by doing so create a marketplace for GI. This market place, however, helps to create and maintain GI in the first instance, as suppliers would either find it unprofitable to produce the product, or if produced, tend to under produce it if they could not be compensated in some way. Copyright is designed to establish ownership and therefore the value of information. In the UK, this has made it possible for government agencies to sell data to the public and other organisations at prices that permit cost recovery (for example, the OS has operated on this basis). This is not possible in the United States as federal agencies cannot be copyright and therefore have can only regain the cost of copying the information and have no control over resale.

In the UK, property rights ensured the early commodification of GI in the marketplace. This left subtle anomalies in the law due to the delicate balancing act struck between access, ownership and economic factors. Information had value because it could be used to make decisions about the allocation of scarce resources. A lack of information could result in decisions being made under uncertainty. Undoubtedly, this would increase the risk of bad decisions (which would entail additional costs) being made with potential social or environmental consequences.

Problems existed because it was often unclear who owned the GI, especially when value could be added almost instantly with geospatial technologies due to the ability to overlay and spatially join different existing form of GI. Not only this but the value of the information created was also unclear. If decision makers could access GI and use it to reduce uncertainty in planning, investment and development then should this not be added to the value of the GI, and, if so, could these multiplier affects ever be assessed accurately? What if the GI does not achieve its goals, should it be

devalued? Does rural GI have less value than urban? The types of questions highlighted show that we have limited understanding in terms of how GI and any resulting representation (such as a map) can be used as a form of evidence. After all, can maps with their uncertainty be used as objective, neutral forms of evidence to resolve conflict or do they in fact function in another way? The law, as it currently stands, appears to protect GI to the detriment of its representation.

3.2.7 Research and Development

Many technical problems were still to be resolved at the time of the Chorley Report and research and development mainly focussed in this area to begin. There was a perceived need to remove human involvement in spatial decision-making (technological determinism).

Since research has moved towards user centered issues (data quality, data fusion and technologies for day-today problem solving situations) rather than advancing technology itself. Social, economic and societal issues were also becoming part of the research discourse (Martin 1991). A new focus had developed based on issues of cognition, visualization, collaborative mapping and metadata. As such several studies began to look on what constrained the use of GIS in practice and began to add social theory to these technical practices.

3.3 The Diffusion of Geospatial Technology in Organisations

Several studies have started to explore the intricacies of GIS diffusion within organisations and helped to theoretically develop concepts linked to the spread of geospatial technologies. They have explored and documented many of the barriers outlined in the Chorley Report. Within these investigations (that mainly focus on GIS), three main theoretical areas have been outlined. These are technological limitations, organisational factors and institutional factors (e.g. lack of national coordination). Generally, these studies have suggested that the way in which staff are organised, and the culture of organisations, plays a larger role in limiting the use of geospatial technology than the technology itself although technological issues can perpetuate existing organisational issues. Sieber (2000, p. 16) refers to the work of Markus (1983), and suggests "simply laying an innovation on top of old processes

will not induce the implementation to succeed." However, this was often found to be the intention of managers as GIS was lauded for its efficiencies.

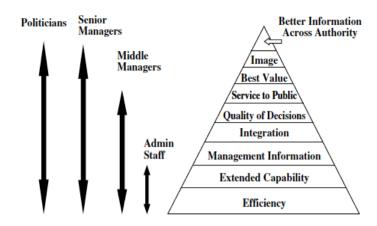
Gill et al. (1999) noted the changing role of planning departments, acting as 'custodians' of spatial data as GIS became diffused within central and local government. They suggest that for GIS to work in organisations it demands that a range of managerial operations are set in place; the data is made accesible in a suitable format to relate to the tasks at hand, and that this data is stored in its most fundamental form (not aggregated to higher spatial geographies) as well as a whole host of ever changing hardware and software factors. In this way there would be one central copy, securely stored and maintained. In fact, Petch and Reeve (1999) also concluded that building a successful GIS project depends at least as much upon issues such as marshaling political support within the host organisation; clarifying the business objectives which the GIS is expected to achieve; securing project funding and enlisting the co-operation of end-users, as upon technical issues relating to software, hardware, and networking.

3.3.1 Social and Cultural Barriers within Organisations

Gilfoyle and Thorpe (2004) also suggest that GIS had a benefit profile within an organisation (see Figure 3.5). In practice, however, several further studies have found that many of the ideological benefits for organisations, such as LAs, were not being fully realised. Innes and Simpson (1993) argue that because the benefits of GIS are difficult to observe and materialize in the distant future, they are unlikely to persuade decision makers to fund GIS.

Petch and Reeve (1999) looked at the role of Information Systems (IS) within organisations and highlight the increasing importance of GIS within an organisation. They warn however that getting the GIS wrong could have consequences for the overall performance of the organisation or company. So does getting mapping wrong in policy making have consequences for the people of Wales? The use of maps, diagrams, and other spatial images have become increasingly used in policy documents but if the representation results in misinformation or is ineffective it can have detrimental effects to the policy or, as with a GIS within an organisation, contribute to the failure of policies and programmes.

Figure 3.5: GIS Benefit Profile



(Gilfoyle and Thorpe 2004a)

In the UK, the removal of barriers appeared to have been more difficult than expected, as ten years after the Chorley Report much valuable public sector geographic data continued to be virtually inaccessible both within government as a whole and to the private sector (Heywood, 1997). Higgs (1999) adds that there had been a lack of progress in terms of organizational cooperation in terms of data sharing and explains that:

"the well-rehearsed argument that Geographic Information Systems (GIS) present a technology whereby spatially consistent data from a variety of different sources can be integrated to address environmental problems is challenged by the lack of truly collaborative exercises of this nature".

(Higgs 1999b, p. 233)

It seems that barriers exist and prevent collaboration and could, in turn, lead to duplication of effort and resources. Nedovic-Budic and Pinto (2000), for example, note that "in spite of the obvious benefits in terms of efficiency and effectiveness to be derived from sharing geographic information both within and between organisations, the idea continues to be resisted, leading to inefficiencies from duplication of data collection and storage". Despite the draw of GIS for organisations it appears to be failing to meet the needs of collaborative practices - but why?

There appears to be an increasing recognition that the function of GI and GIS in any organisation is not merely a technical matter. A diverse myriad of cultural, institutional, organisational, societal and personal settings influence the process of

implementing and exploiting GIS (Campbell 1999). There is much ambiguity in how to conceptualize the interface technology, people, and their work within organisations, especially in terms of how this can be understood in a wider societal context. However, it is within this complex network of interactions that representations of rural statistics emerge. It is therefore important to consider how mapping has been theorized as operating in practice within organisations.

Campbell and Masser (1995) have shown that the use of GIS in organisation can conveniently by caricatured into three main types of approach: technical determinism, managerial rationalism and social interactionism. Table 3.3 outlines the main assumptions behind each style of implementation.

Table 3.3: Three Perspectives on the Implementation of GIS

| | Style of implementation | | | |
|----------------------|-------------------------|------------------------|----------------------|--|
| Assumptions | Technological | Managerial | Social | |
| | determinism | Rationalism | Interactionism | |
| Nature of technology | Machine and | Machine and | Machine, methods | |
| | methods | methods | and knowledge | |
| Nature of | Machine | System | Culture | |
| organisation | | | | |
| | Technical process | Guided by a rational | Organizational | |
| Style of | | management | process which is | |
| implementation | | strategy | problematic and | |
| | | | uncertain | |
| Constraints on | Technical capabilities | Poor management or | Interaction between | |
| implementation | of innovation or | technical capabilities | social and political | |
| implementation | stupidity of users | of innovation | processes | |
| Likely outcome of | Greater efficiencies | Greater efficiencies | Uncertain | |
| implementation | and more rational | and/ or more rational | | |
| implementation | decision making | decision making | | |
| Underlying | Instrumental | Procedural rationality | Communicative | |
| philosophy | | | rationality | |

(Campbell 1996)

The authors are quick to suggest that technical determinism; managerial rationalism approaches are deeply flawed, when used to implement GIS in an organisation. Reliance on technology alone to rid inadequacy in human capabilities and create idealized data-sharing environments rid of duplication of effort has not been

witnessed, nor too has it under appropriate management. Instead they turn to Hirschheim (1985) and liken organisations to social arenas where ritual, negotiations and power predominate. This suggests that political interactions are more likely to ensure the outcome of mapping in an organisation.

Cultural factors in and between organisations make each unique. According to Campbell (1999), this does not imply anything goes but has important practical and theoretical implications. Geospatial technologies are not dissociated from the interplay of organisational life; rather they are subject to its vagaries and power relationships. Therefore, whether specific actors choose to collaborate or compete are important points to consider especially in a political arena. These simple choices can affect how the GI is available and shared and how technology is used to do so but can also framed by local and wider organizational factors.

Campbell and Masser (1995) provide guidelines that need to be considered by managers thinking of introducing geospatial technologies:

- Simple applications of the technology that is critical to the work of the
 organisation, realising that sustainability of the system requires procedures
 that are not resource intensive (staff, time) and there is realization that use
 and output is not value neutral.
- That there will be limitations with any organisation in terms of accepted practices, skills and resources to fully make use of all the technologies capabilities and difference in attitudes towards these technologies.
- Using changing technology requires an acceptance by the organisation to undergo change and champions for this change.
- That key users need to be identified and given responsibility for their development in related areas (enrolling a wider audience).

(Campbell and Masser 1995)

The outcome of this work suggests a change of thinking in terms of how geospatial technologies operate in organisations. Focussing on how the world is rather than

idealized assumptions of how it ought to be might perhaps help waste resources on technological fashions that are not appropriate to certain scenarios. As noted by Campbell (1999), a greater understanding of sociopolitical processes underpin the use and abuse of technological innovations. Therefore, rather than attempting to keep pace with technology instead existing theoretical implications needed to be carefully considered in order for its future uses to be understood.

Nedović-Budić and Godschalk (1996) have also examined GIS diffusion inside local governments in the USA. They explore the topic in terms of the impact of human factors; internal organizational context; external organizational environment and GIS management activities. Using a multiple-case study of agencies within a North Carolina county government, the authors find that GIS diffusion is a very complex process. They conclude that perceived relative advantage; previous computer experience; exposure to the technology and networking are the most significant causes of employee readiness to use new GIS technology, while organizational and GIS management factors strongly influence GIS diffusion.

Similar to the US study, Gilfoyle and Thorpe (2004b) suggest that GI practice in local government in the UK was quite different to the evidence portrayed in early telephone and postal surveys. GIS use was highly concentrated within a very small population of interested individuals. Despite a wide coverage, in terms of organisations, it was not comprehensive and the people using GIS were as sparsely distributed within these LA and departments as settlements are in rural areas. Therefore, the use of a conceptual framework based on 'diffusion' to explain the development of GIS within organisations may just as readily be conceived of as 'translation' as discussed in actor-network theory. In this sense, a technology only makes sense when used by an 'actor' with interests and roles. What gives meaning to the technologies then, are the way in which actors translate themselves with the worldviews of others and the way they preserve or confront the status quo (McMaster et al. 1997). Using this perspective, it becomes clear that technology would not spread evenly amongst organisations and be used in a standard manner as has been noted in previous studies.

Casting a different lens on the issue, Erik de Man and van den Toorn (2002) specifically unpack the cultural factors associated with the adoption and use of geospatial technologies within organisations. Again a framework has been developed to assess good practice. From a social constructivist perspective the author's state

that any analysis of human computer interaction needs to take place with consideration of the social domain within which organisations; professional associations and producer-user relationships exist. Analysis needs to go beyond the behavior and psychology of the individuals involved.

The framework considers three interlinked themes, namely: technology, social demand cultural feasibility. The first theme is concerned with the appropriateness of technology for the organisation. Technology is considered to be a vector of many properties and not some technique, product or process 'out there'. Therefore the appropriateness of incoming technology is how well the multi-dimensional properties fit with existing recipient systems (e.g. practices, technology, culture). The next theme relates to how social groups or society may have a demand for a particular type of technological innovation or may redefine existing technologies to their purpose leading to older technologies becoming lost. Furthermore, a cultural desirability for technology exists and draws technology in to a particular social context. Cultural feasibility then influences the spread of the technology within the social context and how effectively the technology is applied.

Next, they look more closely at the role of culture and make a distinction between societal and organizational culture. They recognise that a nation can have sub cultures (e.g. rural Wales) but, nevertheless, do form historically developed wholes. Within a national culture, organisations exist with their own particularities. With regard to geospatial technologies, these include style of bureaucracy and the approach to decision making. They suggest that organisations can act as intermediaries between GIS technology and society (similar to Söderström (1996), see the next section).

Using the reductionism and principles of Hofstede (1980; 1997), the authors suggest the culture of organisations can be split to three main areas: power distance, uncertainty avoidance, and masculinity versus femininity (described in Table 3.4). By matching these cultural frameworks to common geospatial technology applications, such as communication, strategic planning and operational planning with monitoring and evaluation, barriers are shown to exist. Moreover, the paper shows that task congruency (how simple it is to do old tasks with new technology) and competition (compulsion to seek innovation) can themselves become barriers to the adoption and use of geospatial technologies, such as GIS, and need to be considered within this framework of culture.

This work has shown that cultural desirability depends on how geospatial technologies can help support culturally desired organizational functions and the feasibility of this is governed largely by the specific conditions within each organisation.

The framework is particularly useful as it enables a deeper understanding of the different cultures in place within policy-making organisations in Wales and elsewhere. These differences in culture are therefore particularly important when considering how rural statistics are represented and understood within policy making. Especially when dominant cultures enforce normative practices that cause issues to remain hidden which can be to the detriment of people living in Wales.

Table 3.4: Different Types of Organizational Culture

| Power distance | Uncertainty avoidance | Masculinity versus |
|-------------------------------|--------------------------------|-------------------------------|
| | | Femininity |
| Distinguishes between | The culture of risk, and | Cultures that focus on |
| hierarchical, authoritarian, | distinguishes between | achievement and success |
| and elitist culture (that | minimal risk-taking, which | compared to those that |
| accumulate good things at | results in minimum | emphasise quality of life, |
| higher levels and bad at the | innovation, conservatism and | networking and relationships. |
| lower) and flat organisations | thorough planning for | |
| that value participation and | security and stability. | |
| the spread of both good and | | |
| bad things in life. | This contrasts with innovative | |
| | and creative cultures that | |
| Shown to be related to | tolerate differences in views | |
| individualism and | and behaviour and plan in | |
| collectivism, in terms of | increments with few | |
| calculating citizens, versus | contingency scenarios. | |
| those who have group values | | |
| and contribute to a common | | |
| good. | | |
| | | |

(Erik de Man and van den Toorn 2002)

3.3.2 Mapping Processes

The previous studies have highlighted that despite facing many barriers geospatial technology was incorporated in planning and policy making in the UK (and elsewhere) in multiple ways and could be found in many guises. Despite not being widely used in all departments, geospatial technology remained an attractive prospect for local government and related agencies. According to Nedović-Budić and Godschalk (1996), factors included an ever-increasing quantity of spatially referenced data (that was partly increasing because of the technology itself); the information being a fundamental resource for governments (Howard, 1985; Repo, 1989) and the pressure for improving government performance (Osborne and Gaebler, 1992; Gore, 1993). These factors appear to hold both in Europe and the USA.

Dühr (2007) suggests that the framework provided by Söderström (1996) should be used to understand how mapping is used during planning processes. Söderström (1996) suggested that spatial images are the crystallisation of the thought of planners as they go about their work. In a similar fashion to DiBiase (1991) (see section 2.15), Söderström (1996) describes that the geographic images used in planning represent reality according to a system of procedures such as selection, schematization and synthesis. However, according to Söderström, in planning there is an 'internal efficacy' of the representation exists which allows the translation from one complex reality to a simplified configuration. At the same time, there is another force acting called the 'external efficacy' of representation which is linked to the persuasive power of the image and hence the capacity for certain types of representation to win over public opinion and coordinate action (Dühr, 2007).

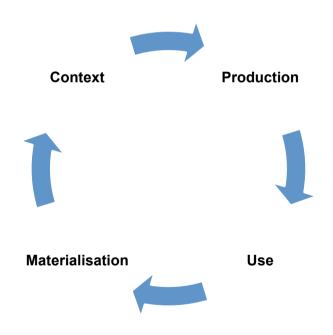
Söderström (1996) seems to relate visualization more to power than DiBiase (1991), who concentrated on the communication aspect. Geospatial representations provide the organisation with specialist knowledge, which can be manipulated to suite the external needs of the organisation. Söderström suggests that external efficacy is often enough to persuade non-professionals of the legitimacy of the planning polices or intended actions. He follows by deducing an intrinsic link between internal and external efficacy, which is especially true for the communication of planning policies outside the circle of professionals (Söderström, 1996, reported in Dühr, 2007). Therefore, it seems that when mapping practices are used in decision making the power within and behind the representation needs to be considered. Therefore, the

role of a mapping is important during the planning process and even the simple point where the map is brought into play needs to be carefully considered. The map can frame the discussion.

The implications of this link between internal and external use is that mapping is multifaceted. It is difficult to, if not impossible to, separate the 'technical' procedures for the preparation of cartographic representations from the social and political uses to which these representations are put to use in the outside world. Mapping is, therefore, political if it is put to use in political debates.

Söderström has also suggested a model he calls the 'visual circuit' (see Figure 3.6). He explains that the model can be used for analysis of cartographic representations in the planning process.

Figure 3.6: The Visual Circuit



(Söderström 1996)

The model is made up of four interrelated fields: the context of elaboration; the process of production and the context of the use of the visualization and the materialization or implementation.

Context

This stage is influenced by social and historical conditions in which planning takes place and which result in giving meaning to representations (Dühr, 2007). Therefore,

a dominant conception of space might be reflected in the types of map produced because of the organisation's culture or tradition or might be framed by the organisation's position within a network of organisations. It is within this context that an awareness of issues regarding mapping rural statistics would need to become commonplace.

Production

The methods in which maps are produced; what is selected and how it is encoded are, for example, selection, scale, schematization and symbolization of the physical elements of which it is composed (Dühr, 2007). This is where the map maker's skills and knowledge are put to practice. This, in addition to context, can determine what is modeled and how it is presented. This is where technological developments (Chapter 2) are put to work. It is here where best practice would be needed when representing rural statistics.

Use

This field relates the process of decoding to an audience and the social use to which the cartographic representation is put. The requirements of different user groups may affect the design and complexity of the visualization. Here visualization instruments could be used to support consensus building and the collective elaboration of knowledge in the planning and decision making process (Dühr, 2007). The representation might also have unintended uses (see Forester, in Figure 3.4). The type of use and audience might affect how rural statistics would need to be represented. But adhering to all interests is increasingly difficult in multi-actor environments

Materialisation

The implementation of a plan, programme or decision and the social, economic, and cultural effects of the strategy in visually organising the territory (Dühr, 2007) – essentially, the outcomes of mapping practices. Infusing an awareness of rural statistics and best practices to deal with issues in earlier stages of production may result in 'hidden' rural issues being tackled.

Although idealistic and presenting mapping practice as a one way, albeit cyclic process, the concepts will help to assess differences in practice during the field work stages of this thesis.

3.3.3 Mapping and Interaction

Montford (2008) goes a step further and explores issues and factors that would lead to the production and comprehension of key diagrams to allow for its effective use. As such, it builds on the work of Söderström by assessing the material outputs of internal and external efficacy cycles. The study also suggests an interesting new reading of MacEachren's (1994) Cartography³ diagram with regards to planning.

In the diagram, the original cube summarises map use in three dimensions, taking into account the two main approaches to map use (i.e. communication and visualization) and the two main realms in which maps operate (i.e. the private and the public realm).

- 1) Communicating \rightarrow Known Information \rightarrow Non-interactively \rightarrow To the public
- 2) Visualizing → Unknown Information → Interactively → To a private audience

According to Montford (2008), key diagrams do not fall within any of these approaches but adapts them both. The key diagrams, which are static maps, are used to communicate known and unknown information in the form of existing and proposed planning strategy for the area to the public. This is done in an interactive environment, which is through public consultation.

3) Communicating \rightarrow Unknown & known \rightarrow interactively \rightarrow to the public

According to Montford (2008), the bad key diagrams fall into category '1' which explains cartographic communication in which maps are used as a means to communicate known information in a non-interactive environment to the public. Examples of maps used this way are OS 'paper maps' that are not prone to interactivity present 'factual' information to the public. The good key diagrams were found in category '3'. In these cases, the representation helps to communicate both known and unknown information in an interactive public environment.

The key diagram is a static 'map' that could be interacted by its users and, secondly, it presented analytical information, which could be known, or unknown. Thirdly, it could be used by anyone at any of the realms: private and public. Therefore, the cube should be redrawn with communication at the heart.

The implications of maps bringing people together to interact, learn and communicate together suggest they might have several benefits for policy making and planning. It is important to next explore further what is happening in Wales as governance in Wales has been designed around theses collaborative practices.

3.3.4 GIS in Planning Authorities in Wales

Gill et al. (1999) have undertaken the most recent academic study of GIS in local planning authorities in Wales. Using surveys the authors explore the progress of GIS applications in planning departments. They provided a concise summary of the history of surveys for investigating similar issues linked to GIS. Interesting findings include the fact that most GIS were being used for operational tasks and there was limited use for strategic purposes. As a result GIS was being underutilized in areas of increasing importance for central and local government.

Reflecting on previous studies they suggest that many authorities still lacked a cooperate focus and the GIS lacked appropriate analysis tools for strategic tasks (e.g. useful for taking a snapshot in time but less useful for change over time) and connectivity and interoperability of data continued to be major weaknesses. As a result they note that 90% of survey respondents felt that the technology was not being used to its potential.

The study also found that most collaboration and data sharing involved non-personal data, was fragmented, and related to the environment. Much of the advanced (e.g. 2.5D and Virtual Reality) development of GIS for planning focussed on urban areas. Although not focussing specifically on socio-demographic uses this study notes how this could be problematic for strategic planning because of technical and theoretical problems noted elsewhere (Openshaw 1991; Aitken and Michel 1995). The study also suggest how the pragmatics of local government reorganization could disrupt existing technological and organizational practice and noted that this had consequences in terms of continuing GIS development.

Looking to the future they suggested that there was potential for GIS to become used as part of a broader suite of tools as planning support systems. They noted how there had been limited progress in this area despite the technology existing and the potential for incorporating multimedia within these processes.

Since there has been further research in to how GIS can be used to determine service provision (Higgs et al. 2003; Higgs et al. 2004; Higgs et al. 2005; Langford and Higgs 2006) and how it can be used strategically for linking geodemographic classifications with fire incidents, health and crime (Corcoran et al. 2013). Therefore there is a growing body of research and a widening breadth and body of uses. This suggests that the representation of rural social and economic statistics is going to increasingly prove important in ensuring equitable representation during these activities. How geographical information passes between people and organisations is important.

3.3.5 Movement of GI In and Between Organisations

Petch and Reeve (1999) highlight the pathways in which information tends to flow in an organisation. GI is expected to follow similar pathways (subject to the legal constraints mentioned in Section 3.2.6). It is suggested that there exists a division between management and IT specialists within organisations and go as far to describe there being two domains to distinguish between the business and the IT cultures within a company. These are the business domain and the technology domain, but both are dependent on each other for skills or income.

In a similar fashion, when producing a policy document there is a division between when the information is used by researchers, to explore and analyse the data and produce efficient representations that convey the most information in the least amount of space, and when it is being used by the government that has a more political interest and use the visual representation as a persuasive tool or to make a public statement.

Therefore, it seems that the role of information systems within an organisation could provide a good template or starting point to compare the mapping stages in policy making as GI moves between people in an organisation. This type of organisation is not like a business whose goal may be to make money but more a non-profit organisation whose goal is more socially orientated. However, as noted earlier, GI causes even socially orientated organisations to act like a business.

Petch and Reeve (1999) look at the roles that information systems fulfill and the levels at which they are used - with and between organisations. They use the concepts of Huxhold (1991) to produce a model of computing in which information

systems are viewed as pyramids, with three different levels of information management (see Figure 3.7).

These stages include:

- (1) Policy Level: This level involves a relatively small group of top decision makers and deals with organization-wide concerns and determines the organisation's strategic direction.
- (2) Managerial Level: This level middle level consists of managers, researchers and administrators whose tasks include monitoring performance of lower layers in the pyramid, researching the external environment, and preparing policy options for the top layer.
- (3) Operational Level: This level involves the production process.

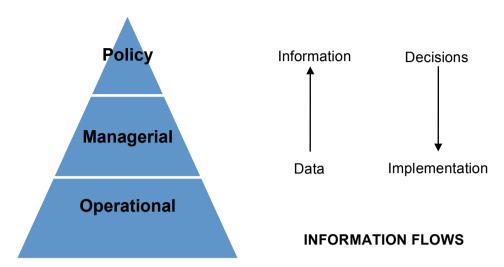
Figure 3.7: Hierarchical View of an Organisation



(Petch and Reeve 1999)

Petch and Reeve (1999) present organisations as simplistic, ordered and structured, which in most cases they are not. Nevertheless, the pyramid provides a useful heuristic tool for understanding how GI can be transformed within organisations.

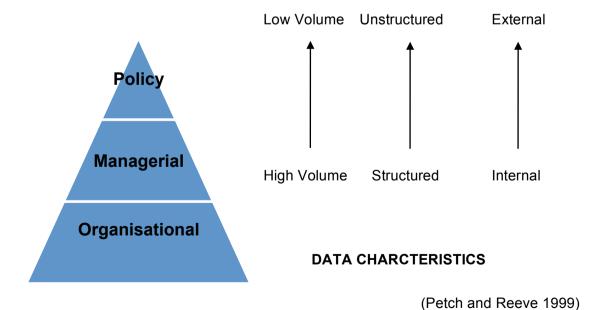
Figure 3.8: Information Flow within a Hierarchical Organisation



(Petch and Reeve 1999)

Figure 3.8 suggests staff at the operational level work with data when it is in a raw state; it needs to be transformed in some way to suit the needs of the individual or others around them. Those at the policy level use resultant information to make organisation-wide decisions; these decisions are then translated for implementation at the operational level.

Figure 3.9: Change in Data Characteristics



The other main points that can be interpolated from these diagrams with reference to the use of GI within organisations are with regards to the type of data flow, direction and characteristic. These stages are summarized with reference to the organisations that existed in the 1990's.

Operational Level – High volumes of data, that change frequently, but tend to be similar in type. Systems required to store and handle these data. Limited spatial analysis.

Management level – multiple data sources: can be from the operational level and passed to management or from external sources e.g. government statistics, market research or anecdotal. All sources compared against what has been set by the more authoritative level. Data is refined to report to this level. It is more varied and less voluminous than at the operational level.

Policy/Executive level – Strategic decisions are made at this level. These are non-routine, complex, unstructured and critical. Information should be highly refined summaries of internal and external conditions prepared by middle layer. This level is concerned with detail. The types of info that might be included: comfort information, warnings, key indicators, and key external information.

(Petch and Reeve 1999)

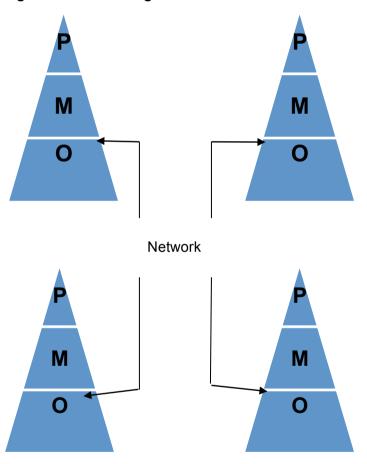
The top level information could be equated to the things on a car's dashboard. On the executive's screen, would be a range of key indicators to show that everything is going in the right direction, at the right speed, and nothing is about to 'blow up'. Huxhold (1991) suggests that for all this to work information systems need to be effective on all three levels.

As data moves up through the pyramid, it becomes information; this could be related to Cartography³ and the going from unknowns to known axis. Another similarity is with the amount of interactivity with the data, with the implementation coming from the bottom level of the pyramid and the less 'hands-on' decisions coming from the top. The third similar dimension is the internal to external flow of data, which relates to the private to public audience axis in Cartography³. Therefore, when relating the cube to DiBiase's (1991) stages of visualization, it is clear that geospatial representations will need to take on different forms dependent on who is using them

within the pyramidal (or maybe cubed) space of the organisation. Therefore, representations need to be effective on all three levels of the pyramid.

According to Petch and Reeve (1999), a limitation of the triangle approach is that it focuses upon individual organisations. The links between organisations also need to be analysed (example shown in Figure 3.10). How should visual representations transfer between organisations and at what level in the organisation should they be transferred between (i.e. should operational visualizations be shared only at that level between organisations)?

Figure 3.10: Inter-Organisational Information Flows



(Petch and Reeve 1999)

This literature is useful in several ways: firstly, it explains that we need to consider how GI is utilized within organisations - it does not just serve one purpose. Secondly, it shows how the use of information in organisations has changed quite dramatically over the last decade or so, position organisions closer to Figure 3.10 than a whereas the map maker has assumed the role of the organisation in Figure 3.7 in that they have to deal with policies, manage data for policies, and operate the data within

geospatial systems. In addition, there is now a much different and multifaceted flow of data and information.

Even within network approaches mapping is still reliant on spatial boundaries as the unit for analysis. Since this thesis began there have been a number of important developments in how spatial data about households, the surroundings, and the individuals who live in these households can be linked (Rodgers et al. 2009; Rodgers et al. 2010; Rodgers et al. 2012; Rodgers et al. 2014). This work illustrates the importance of geo-privacy and the need to consider new pathways through which information flows between organisations.

Procedural techniques have been developed based on what have come to be known as Residential Anonymous Linking Fields (RALFs). Personal characteristics can also be joined using Anonymised Linking fields (ALF). Both can be brought together for analysis without the need to worry about privacy issues as the procedural formality of this method to a large extent removes these issues. This emerging topic of geoprivacy should prove particularly relevant for the representation of hidden rural issues as it means that future mechanisms are developing that enable representation to not be so weighed down by boundaries, making it possible to develop more nuanced solutions to enduring problems in health but potentially also in other social and economic areas.

3.4 Progress towards collaborative social and economic mapping

Geographic research, decision making and education have increasingly become group activities (MacEachren 2001) so it only seems fit that rural representations of social and economic statistics will need to be designed for these group activities.

GIS and related Decisions Support Systems (DSS) were initially developed for use by individuals rather than groups. GIS did not easily permit collaboration but was nevertheless designed to support spatial decision making through the ability to store, manipulate, and analyse spatial data using commercial software packages (Maguire 1991). It has been argued that the GIS design was not flexible enough to accommodate variations in either the context or processes of spatial decision-making (Geertman and Stillwell 2003). The problem for decision-making is that different people can place different values on variables and relationships, and select and utilise information in a variety of ways and hence require flexibility in the display

mechanisms to assist communication. Nevertheless GIS and DSS were regarded as early examples of Planning Support Systems (PSS).

PSS has been defined in many ways but tend to refer to the body of geo-information technologies and digital techniques (such as GIS) that can be used to support processes involved in policy making and planning. As a framework then PSS incorporates tools that can support public or private decision making processes that vary in time and in scale. According to Geertman and Stillwell (2009) PSS tend to encapsulate GIS (when there is a specific focus on geographic data), DSS and other types of spatial decision support 32 and mesh them together for long-term and strategic tasks.

Within PSS instruments relating to geo-information technology have been developed to support problem diagnosis, data collection, mining and extraction, spatial and temporal analysis, data modelling, visualization and display, scenario-building and projection, plan formulation and evaluation, report preparation, enhanced participation and collaborative decision-making (Geertman and Stillwell 2004). To support collaboration a number of PSS have utilised venues (electronic conference board rooms), virtual networks, and have molded existing technologies to suite group tasks related to policy and planning.

Despite best intentions Geertman and Stillwell (2009) note that PSS have often failed to materialise in practice and if they do the dwindle after the initial novelty has worn off. In addition some PSS can be subjected to the same type of criticism as GIS (elitist technology, reinforcing power, selective access to information) despite potentially widening access amongst similar types of planning organisations. Distributed GIS is a relatively recent development and provides the network architecture upon which GI, software and related platforms can be shared between people working in different organisations (see section 2.1.7). Web mapping (such as

³² Spatial Decision Support Systems (SDSS) refers to the use of computer technology to assist people in the development, evaluation and selection of appropriate policies, plans, scenarios, projects or interventions where the problems have a geographic or spatial component. As such a heterogeneous mix of information for multiple interested parties need to be considered and integrated with appropriate technology and tools.

Google Earth) and open source products also provide a platform for sharing map related information. However development in these subjects has focussed on technology and is less concerned about how people can actually make spatial decisions as a group.

Carver et al. (2001) and Kingston (2007) have suggest that Public Participation GIS (PPGIS) could help overcome the criticisms directed towards GIS (and some PSS) by creating a more level playing field on which to conduct public debate. PPGIS belong to a family related tools and processes that include Participatory GIS (PGIS), Participatory Planning Support Systems (P-PSS), and Public Participation Planning Support Systems (PP-PSS). Despite the deluge of acronyms each of these systems is simply linked by their function to enable community groups and marginalised individuals to actively participate in public functions and decision-making. These types of developments, towards democracy in mapping practices (facilitating collaboration and inclusive participation), have been welcomed by researchers advocating Critical-GIS (e.g. Elwood, 2006).

Recent PPGIS have used internet-based approaches to broaden access and open up participation potential 24 hours a day. Kingston et al. (2000) have developed a framework for internet-facilitated PPGIS based on the criteria – explore, experiment and formulate. The participants can explore the decision problem utilising an underlying GIS database and experiment with possible alternative solutions before formulating their own decisions as to the best course of action. The information accessed and the choices made in reaching the solution, along with the final decision are then fed back using the Internet for scrutiny.

Despite Internet based spatial decision support tools being adopted relatively few studies have used such technologies to incorporate public views and opinions in relation to current policy and planning issues. This is despite citizen participation being promoted in recent decades as a mechanism to ensure greater democracy leading to better outcome for citizens (Civicus, 2012). Traditional forms of public involvement in the planning process can create a division between 'them and us' — with reference to authoritative decision makers having exclusive access to knowledge, expertise, and power. The extent to which the public can actually be involved has also been questioned (Thomas, 1995; Healey et al. 1988) especially when the vocal minority could dominate the debate. Kingston (2011) suggests that technology could overcome some of the existing problems by offering a non-

confrontational means of participating. PPGIS is particularly important as it can be used to gain insight about people at the grassroots level and utilise local knowledge. This would enable decision makers to become more in tune with local feelings and needs.

Systems developed to date to overcome this divide have largely involved prototype tools that have explored the use of participatory GIS approaches in environmental applications (Kingston et al., 2000). The majority of which have not been applied in Wales. Those that have been put to use in Wales (for example in Wind Farm planning) have not placed emphasis on the representation of social and economic issues. Importantly however these systems have been designed to capture spatial opinions (that may well have social and economic components) of not just key stakeholder organisations but also the public.

Carver et al. (2001) found there were still specific issues related to IT training, Internet access, and copyright that were found to cause problems in participation. The increase in open source products and the PSMA may overcome some of these issues but there still remains somewhat of a "digital divide" for some members of the public. Monmonier (1996) also suggests that when people are armed with GIS technology and not the training to sit alongside then they can be left open to criticism from those in more powerful positions, and this argument is still true today as it was twenty years ago. However Carver et al. (2001) argue that carefully designed interfaces can circumvent the issue by controlling the users actions. However this assumes the underlying information to be a stable product.

A question mark therefore remains in terms of how geocollaboration would work during processes linked to representing rural statistics for policy making and planning in practice. This will be returned to later in the conclusion.

3.4.1 Change to Distributed GIS and Collaborative Networks

Maceachren and Brewer (2004) also suggest that groups commonly work with GI collaboratively; however, mapping is often done in isolation. They suggest that GIS is designed in a way that only permits one person to interact with the GIS and has developed, until recently, along this pathway.

The authors promote the use of the visual medium as an ideal mechanism for

collaborative decision making. They define 'collaboration' as activities in which two or more people work with each other on a single task or closely related subtasks, constructing and maintaining a shared problem conception. Further, they suggest that, when a committed effort is made by two or more individuals to use geospatial technologies to collectively frame and tackle a problem involving GI, it should be termed geocollaboration. Therefore, when policy makers make decisions using maps they are part of a geocollaboration.

According to Maceachren and Brewer (2004), we are on the cusp of a substantial increase in the role of maps, images and computer graphics as mediators of geocollaborative working, further suggesting that the visual representations that emerge from software such as GIS have particularly important roles in these activities. They find the general lack of attention to the role of the visual display surprising since most GISystems use visual, map-based interfaces.

The outcome of their study was the finding that there are limited conceptual frameworks developed enough to study these issues. Maceachren and Brewer (2004) follow to propose that such a framework should delineate important, technological, social, and cognitive parameters so that we can better understand parameters that define geocollaborative environments. Such a framework could help to understand the use of GI, software and technology, by those working in future policy-making environments in Wales.

3.4.2 A Conceptual Framework for Geocollaborative Environments

Maceachren and Brewer (2004) outline a framework that consists of six main dimensions - half of which are mainly human centered with the remainder focussing on systems and technology. The human factors, shown in Table 3.5, revolve around the contexts in which collaboration is taking place; is it to extract information from the data; explore a problem further to obtain new ideas; to jointly design a local development plan; to choose where is best to locate a wind farm or close/open a hospital or for group training on a spatial issue, e.g. planning an emergency response. There is also a range of collaborative tasks. These group decision making tasks can be matched with knowledge construction tasks (based on Hackman (1976); McGrath (1984); Tukey (1977); DiBiase (1990) and MacEachren and Kraak (1997). The third human factor is dependent on the position of those collaborating. A

continuum of positions exists from one extreme where opposing views exist; here the visual medium can be used as a go-between to resolve the conflict and come to a common understanding. This contrasts with a situation where those collaborating work towards a common goal. If the number of partners increases, the likelihood that conflict will take place also goes up and so visual medium will most likely need to be tailored towards conflict negotiation. It is important to note that there may not be a commonalty of perspective even based on the same visual representation.

Table 3.5: Human Centred Factors in Geocollaboration

| Problem context | Collaboration tasks | Commonality of |
|-----------------------------|------------------------------|---------------------|
| | | perspective |
| Knowledge construction, and | Generate ideas and options - | CooperationConflict |
| refinement | explore | |
| Design | Choose - Synthesise | CooperationConflict |
| Decision support | Negotiate - analyse | CooperationConflict |
| Training and education | Execute - present | CooperationConflict |

Adapted from (Maceachren and Brewer 2004)

These human geocollaboration concepts coexist alongside a number of more technical factors. The spatial and temporal context, in essence, dictates the types of tools required. Same time, same place activities include collaborative planning and 'planning for real' or activities where people group around a GIS and discuss options. Different place collaborations have recently been facilitated by the development of distributed GIS; however, examples of their use in practice are limited.

Table 3.6 presents a framework for understanding geocollaborative mapping activity. The interaction characteristics depend on the size of groups involved, is it two teams of two people are five groups of ten, and are there sub teams within these groups? The answer dictates the type of interactions possible. In addition, there may be a hierarchical nature to the collaboration where access privileges to certain types of information is only required at certain levels within the hierarchy. There might also be certain members in the network that impede information flow. Certain organisations may also have rules and guidelines that stop the free flow of information between partners. To bring all of these map mediated collaborative activities together requires a host of tools to enable group work to take place.

Table 3.6: Technical and Organisation Factors in Geocollaboration

| Spatial and Temporal | Interaction | Tools to mediate group |
|-------------------------------------|-------------------------|--------------------------|
| context | characteristics | work |
| 0 1: 33 | Group size and | Different tools tailored |
| Same time, same place ³³ | aggregation | specifically to problem |
| | | context |
| D.W. 141 | Topology of connections | |
| Different time, same place | (common, hierarchical) | |
| | | |
| Same time, different place | | |
| Same time, unlerent place | Constraints on form and | |
| | flow of information | |
| Different time, different | | |
| place | | |
| | | |

Adapted from (Maceachren and Brewer 2004)

Chapter Summary

This chapter has demonstrated how little attention has been devoted to the use of maps in planning theory until recently. Perhaps due to maps being perceived as objective and neutral tools for organizing people, possessions and territory. The role of the planner in being able to utlise tools and expertise to solve problems has undergone severe critique. As such it appears that cartographers and planners are in fact much the same. However as planning became a multi-actor discipline concerned with 'place-making', the role of mapping and mapmakers was given limited theoretical attention, despite the increasing role of maps and introduction of GIS.

The introduction of geospatial technology for government was in any case not straightforward but deemed necessary under the premise that the technology would make many tasks more efficient and could save money. Academic attention in the

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³³ Note - participation may be: sequential, simultaneous, and mixed.

1990s appeared fixated on ensuring that the technology was infused as widely and deeply in to government organisations as possible. This was mainly in response to the barriers outlined in the Chorley report.

Several academics began to note that the promise of benefits from geospatial technology was not being realised because of broader political agendas and the local social and cultural barriers that limited mapping within organisations.

However as the Internet developed and more and more organisations collected spatially referenced digital data mapping began to find a niche. It was capable of bringing all this information to view relatively quickly given the correct technological infrastructure, trained staff, organisational 'buy-in'. If the context was favourable geospatial technology could be used for both internal and external efficacy. GI was increasingly being transferred within and between organisations. Social and economic statistics became bound within spatial boundaries and communicated and encapsulated within a mapping interface. However these developments were not necessarily favourable for visualization of rural statistics and could cause rural issues to be overlooked or framed within these technologies without fully exploring the consequences.

Several recent organisational and technological changes have the potential improving exploration of rural statistics. First and foremost information is becoming available for analysis that is less confined to geographic boundaries. distributed systems are making it possible for multiple organisations and people to become part of the map-making process potentially enabling geocollaborative environments. However issues remain as these new developments are in their infancy and moreover many existing barriers are yet to be resolved. Some are barriers beyond the control of those mapping, some beyond mapping organisations, and some are even beyond the control of the WG. As such there is limited coordination and hence organisational awareness of the GI requirements for these new environments. Perhaps more importantly investment will be needed in terms of developing human skills, training and capacity in handling and exploring GI. To ensure this can be developed coherently it needs to be officially factored in to policymaking processes and interlaced with other ways of knowing people and This would help ensure polices are adequately 'rural proofed' and policymaking develops beyond boundaries.

Introduction

The purpose of this section is to provide contextual information regarding the policy and data landscape in Wales for subsequent chapters. In doing so this section outlines some of the main data providing organizations in operation in the UK and Wales and the key policies and programmes that frame how they operate.

Essentially then this section aims to provide the background to the research strategy; however, this section also shows that this backdrop is complex and strewn with both enduring factors as well as elements of change and flux. Therefore the following backdrop provided should be treated as a snapshot taken from within these amorphous settings. A backdrop where policy actors can change structures and structures can constrain actions. It is within these complex settings that people working within organizations access and manipulate data for evidence based policy making and so it is also here that this study of mapping practices takes place. Interpreting often-impenetrable factors within this backdrop, through the experiences of those closest to these activities, the policy actors, warrants the ink on this canvas and presents an arena that is the focus of the case study.

4.1 The Amorphous Landscape of Policy Making

Morphet (2013) suggests that it is essential to understand policymaking within a governance context. The term governance can have a broad range of meanings and is distinct from the term government, which tends to refer to a single hierarchical entity. Governance tends to involve decentralization and fragmentation from one unitary government to sub-national or regional governments, and further to local government and to networks or partnerships.

In the UK governance can be intergovernmental in nature (including EU engagement), or have an international dimension and may link the public, private and voluntary sectors (Birrell 2012). In governance therefore much wider sets of interests are included in the process of developing, delivering and owning policy in order to increase its effectiveness (Morphet 2013). As a consequence a wider set of interests

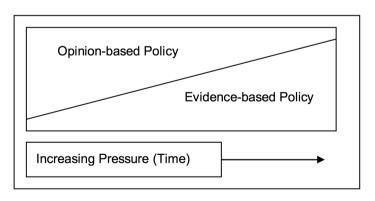
need to be accounted for when using evidence in policy making. This could result in additional data, collected at a variety of spatial scales, according to a variety of institutional standards, all of which may need to be combined to be fully understood.

Rhodes (1997) identifies networks as synonymous with governance such that there can be multiple centers for policymaking. The concept of governance, then, provides a useful heuristic for discussing the post devolution policy making landscape of Wales. The term governance in this study is used in an inclusive fashion to include all that pertains to public and governmental institutions, decision-making and provision.

4.1.1 Modernising Government and Evidence Based Policy Making

The notion of using evidence to inform policy is far from novel. Ancient Greek philosophers such as Aristotle put forward the notion that different kinds of knowledge should inform rulemaking. According to Flyvbjerg (2001) this would ideally involve a combination of scientific knowledge, pragmatic knowledge and value-led knowledge. Sutcliffe and Court (2005) explains how a new emphasis has been placed on this since the turn of the twenty first century. This has been conceptualised in Figure 4.1.

Figure 4.1: Changing Dynamics in Policy



Source: Adapted from Gray (1997)

(Sutcliffe and Court 2005)

It is interesting to contrast this structural conception to the realities most likely face in practice where the dynamics are perhaps reversed. For example with increasing

time pressure may well lead to basing a judgement on opinion rather that evidence. Perhaps it is here that mapping can assist policymaking.

Evidence based policy or the doctrine of 'what matters is what works' became the mantra of the government in 1997, following the election of the UK Labour Government. The Modernizing government agenda confirmed the central role evidence was expected to play in policy making (Davies et al. 2000). This conception of policymaking has been summarized in Table 4.1.

Table 4.1: Characteristics of "Modern' Policy Making

| Strategic | Looks ahead, contributes to long-term goals |
|-------------------------|---|
| Outcome focussed | Aims to deliver real change |
| Joined up | Works across organisational boundaries |
| Evidence-based | Based on all available best evidence |
| Inclusive | Is fair; takes account of the interests of all |
| Flexible and innovative | Tackles causes, not symptoms; not afraid of experimentation |
| Robust | Stands the test of time; works in practice |

(Davies et al. 2002)

It is interesting to reflect on how mapping can serve these purposes. They can be used strategically to plan the territory. They can display desired outcomes and monitor if these outcomes are met. They can have be used to create boundaries and can work without them dependent on the data. They can bring together multiple sources of evidence but tend to prioritize certain types. They tend to prioritize certain interests. They can be used to find where there is need but often do so in a way that does not involve experimentation. Maps endure over time but are not necessarily robust tools. Therefore it appears the role of mapping within policymaking is unclear, there are both strengths and weaknesses.

The Modernizing Government White Paper in 1999 suggested that it is unlikely that Government can succeed in delivering the outcomes that the majority of people want if the policies and programmes that are implemented are flawed or inadequate. This

was why evidence is required for making policies. With this in mind it is important to remember that the use of evidence is just one imperative in effective policymaking, and moreover policy making itself is inherently political. In practice these two factor combine in a way that when reference is made to 'evidence based' policy making it is more likely be 'evidence influenced' or 'evidence aware' policymaking (Segone and Pron 2008).

The modernising agenda set out long-term goals and instigated major initiatives that have framed the role of government information. It also outlined the need for 'Joined-Up Government' to be both effective and efficient in digital data sharing across organizational boundaries when delivering public services. This required the removal of unnecessary regulation bringing in new talent and encouraging innovation. Within this framework partnership working and 'one stop shops' for information were encouraged as there was a focus on citizens needs rather the convenience of service providers.

Coupled with this modernizing agenda was decentralization of the political and administrative structure in the UK. This process of modernizing the democratic framework also impacted on modes of governance, regulations and information and data provision. It placed a spotlight on how local government use, manage and exchange information and the factors that might influence how key joined up initiatives such as health, education and crime prevention operate at a local authority level where most of the data is held (Gill et al. 1999). The modernizing agenda was very much linked to devolution in Wales. The following section will describe how this also led to a focus on rural Wales.

4.1.2 Devolution in Wales

Devolution is an ongoing process in Wales. Loughlin and Sykes (2004) sum up where Wales was in terms of policy making prior to devolution,

"Wales lacked a distinctive policy-making community before devolution, with an under resourced Welsh Office generally applying policies made in Westminster without significant modification, and with major interest groups active in Wales seeking to influence policy in Westminster".

(Loughlin and Sykes 2004, p. 1)

Over time increasing policy making responsibilities have been gradually transferred from Whitehall to the former Welsh Office and following devolution to the National Assembly for Wales (NAfW). The NAfW now acts as both a deliberative and an executive body, responsible for scrutinizing the WG's decisions and policies, holding Ministers to account and approving budgets. It now has power to pass its own legislation in the form of Bills in any of the areas that it has power or responsibility (see Table 4.2).

Table 4.2: Core Policy Topics in Wales

Agriculture, National Assembly Environment Town and country fisheries, forestry for Wales Sport and recreation planning and rural Economic Health and health Fire and rescue development development services and service Public administration Water and flood Housing promotion of fire Ancient monuments Education and safety defence and historic training Tourism Highways and buildings Social welfare Food transport Local government Culture Welsh language

(NAfW, 2013)

A case could be presented for the requirement of social and economic statistics for most of these twenty areas, however, certain areas stand out for example rural development, housing, economic development, education and training, social welfare, health, tourism and welsh language.

There are, however, important exceptions to the list of devolved policy areas. These fall outside the remit of National Assembly for Wales and so Wales is without powers to make legislation³⁴. These include policing and criminal justice, foreign affairs, defence and national security issues, welfare benefits and social security. Not only this but the bulk of fiscal and macroeconomic policy and public expenditure allocation across the UK lies with HM Treasury. In Wales it is possible to set council tax and

³⁴ A full list of these is set out in Schedule 7 of the Government of Wales Act - http://www.legislation.gov.uk/ukpga/2006/32/schedule/7

business rates, but general taxation also remains the responsibility of the UK Government and Parliament (NAfW 2013). This essentially ties the fortune of Wales with the rest of the UK and results in UK Parliament and Government retaining significant powers in relation to Wales and considerable influence over Welsh affairs.

Wales is also subject to decisions about legislation and policy made in Brussels. The WG has a role in the process of policy formulation, negotiation and implementation of EU law where it impacts on a devolved area of responsibility.

Devolution not only created new institutions but also inherited a complex mosaic of existing organizations and responsibilities. Wales and its rural areas need to be understood in context at several scales; from a European perspective; Nationally via Westminster; Regionally (through devolved Governments); locally (in terms of sub regional variations) and perhaps most importantly of all from the perspective of those people living and working within these areas. The challenge therefore appears to be translating the experiences of people living and working in the countryside into something that can be understood for policy making at a variety of scales and from a variety of perspectives. It is therefore important to investigate this further by firstly contrasting between how rural statistics are seen and represented from a national perspective but also from local accounts within Wales.

So it seems that through devolution the scene has now been set for self-reflexive policy making in Wales for Wales however this still needs to be done relative to and within the financial limits imposed by other parts of the UK and using EU funding instruments. Importantly it enables distinct policies and programmes to be developed that address the needs of interests of rural Wales as an entity.

4.2 Scoping the Political Landscape of Wales: The Main Players

The main organizations in Wales with influential roles in policy making are the National Assembly for Wales [NAfW]; the WG³⁵ (a distinct entity from the NAfW); 22

³⁵ The Government of Wales Act 2006 established the Welsh Assembly Government as a distinct entity from the National Assembly for Wales (NAfW). Following elections to the National Assembly for Wales in May 2011 the Welsh Assembly Government became known as the Welsh Government.

Unitary Authorities [UA] (also referred to as local authorities or planning authorities) each containing their own unique mix of urban and rural areas; and Town and Community Councils.³⁶ Within these government institutions there are five 'tiers' of representative democracy. A Member of Parliament (MP), a Member of the European Parliament (MEP), and Members of the NAfW serve the electorate and their local councillor(s) elected to the unitary council (also known as a local authority). In most rural areas and in some urban areas a town and community councilor also serves the public (WLGA 2012). These are the mainstay institutions that provide some degree of order to the complexity that surrounds them.

There are also a range of Welsh Government Sponsored Bodies (WGSBs). These are non-elected public bodies but have responsibilities for public services. They include Sport, Arts, Health Education, and Environment organizations. Health education, police and fire and rescue authorities also organize Wales. This list is not exhaustive but serves to illustrate the point that multiple organizations operate within the same jurisdiction but the way in which their remit is subdivided between organisations differ. Therefore there is potential for duplication of activity in terms of data collection and analysis.

Several of these organizations have recently either been merged or abolished and their functions subsumed within the role of the WG. In 2013, for example, the Environment Agency Wales, the Countryside Council for Wales and Forestry Commission Wales were brought together under a single Environmental body, Natural Resource Wales.

Aside from the hierarchical view presented of public sector organizations a lot of work has developed in terms of what can be termed horizontal relationships. These horizontal links are based on partnerships between organizations and people (Jeffery 2002). The 'three-thirds' principle (community/voluntary sector, public and private) was a uniquely Welsh attempt to "design-in equality of representation in partnerships" (Bristow et al., 2008, p. 905). Partnerships hence can operate in

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³⁶ According to One Voice Wales at the time of writing there are 736 community and town councils representing this lowest spatial level at which local government exists. Here community councils are responsible for services such as management of town and village centers, litter, verges, cemeteries, parks, ponds, allotments, war memorials, and community halls.

Wales at a variety of spatial scales including at the very local community level. An example of partnership working is found in the WG's Communities First Programme that brought together representatives of all interests in deprived communities for the management of funding programmes to tackle deprivation and build community capacity.

A multitude of organizations now seek to advise or influence the work of governments in an attempt to guide their actions. Examples include pressure groups of one sort or another, university researchers, independent 'think-tanks', professional bodies and statutory organizations (Davies et al. 2000). Maps can be used in these negotiations and can provide a powerful rhetorical tool because of their ability to summarise and present a multitude of statistical information while keeping a degree of scientific realism.

There is also a wide range of organizations with a stake in GI and potentially geospatial technologies (see Table 4.3). However only a limited number of these organizations utilize social and economic GI using mapping for policymaking purposes.

Table 4.3: Main GI Organisations, Functions and Users

| Organizations | Functions | User groups |
|-------------------|----------------------------------|---------------------------------|
| EU | Economic development | Geographic data, technology and |
| UK Government | Social services | service providers |
| Welsh Government | Justice | GIS users/experts |
| Local Government | Housing | Researchers |
| Voluntary sector, | Education | Statisticians |
| charities, NGOs. | Arts, culture, sport and leisure | Planners/Policymakers |
| Business | Environment, land / marine | Surveyors |
| Community groups | management | Community groups |
| | Property | Citizens |
| | Public safety and emergency | |
| | services | |
| | Transport | |
| | Utilities and networks | |
| | Insurance | |

(Executive 2011)

Wales's small size may be an important factor in the way it is governed. Relatively few agencies are involved in even the most complex issues and these networks are close-knit and overlapping, with key individuals playing several roles (Thomas 2010). It seems therefore that a relatively small number people have to contend with large amounts of information in order to make informed decisions. In this sense these individuals act as obligatory passage points in terms of policy-making processes. It is through these nodes that rural statistics are recognized in the policy making process.

For the purpose of this research attention will be directed towards the activities of the WG and LAs due to their primary roles and legally obligations within policymaking for Wales. It has been suggested that these are two parts of the policymaking process where most bargaining and negotiation takes place (Barret and Fudge 1981 in Rhodes 1997). They also play a key role in working with local partnerships. They act as information nodes and facilitators for governance networks. Focussing on these organisations makes the research manageable and provides a foundation for further study.

Wales is a small country the interests of Wales have to be channeled through certain nodes within the governance network. These nodes force all previous collective guidance to be condensed to a manageable format so that it can be exchanged between key actors at these nodes. In other words information has to be increasingly condensed according to the needs of the few, those with the greatest network of resources and influence. In these collaborative environments it is likely that there will be a number of worldviews forged within a host of competing and coincidental networks.

As these organizations will be under the spot light it is important to now briefly discuss each in turn and explain their relevance to the policy making processes. The next section summarizes descriptive information mainly garnered from public sector websites in order to provide an integrated summary of the main governance structures and activities that tie together the networks of policy stakeholders in Wales. Important initiatives that tie together these components will also be mentioned (for detailed description of recent activities see the Williams Report, 2014).

4.2.1 The Welsh Government

The WG is elected by Welsh citizens to undertake what is known as a Programme for Government. This involves making decisions and ensuring delivery on devolved areas by developing and implementing policies, setting up and directing delivery and governance mechanisms, making subordinate legislation (e.g. regulations and statutory guidance), and proposing Welsh laws (Assembly Bills) (WG, 2013). This means that key strategic decisions, at a national level, are made by the WG to address local priorities and needs. The bulk WG work is conducted by civil servants who operate under a number of directorates that mirror the devolved areas of responsibility. This work then feeds into the portfolio of Ministers based in Cardiff.

Since its inception, the WG has attempted to promote an inclusive policy process by involving multiple stakeholders from both within and outside government. Strategies are in place to enable multiple stakeholders to contribute mainly to the formative stages of policy development.

The WG has committed to strengthening rural proofing of strategy and policy at the formative stage (WG, 2011). This is an area where the mapping of rural statistics may help influence decisions. These spatially mediated interrelations between local and national bodies with regard to policymaking and planning is the focus of this thesis. It is here where evidence is incorporated; evidence mainly associated with the themes set out in the Programme for Government.

Programmes for Government

Aside from producing a legislative programme the WG, in a strategic document called the Programme for Government, sets out the main priorities for action in Wales over a period of five years. This research has bridged programmes for Government including one produced in coalition 2007-2011 (Welsh Government 2007a) during which there was a global economic crash. The latest (Welsh Government 2011b) produced during a time of austerity is by far the most straightforward to decipher.

The statement contains elements of each of the core themes within the current programme 2011-16:

- Growth & Sustainable Jobs
- Public Services in Wales

- Education
- 21st Century Healthcare
- Supporting People
- Welsh Homes
- Safer Communities for All
- Equality
- Tackling Poverty
- Rural Communities
- Environment & Sustainability
- Culture & Heritage of Wales

The document suggests a number of performance indicators upon which action can be judged. Rural communities are a specific action area, the government aims to,

"Ensure that rural communities remain vibrant and able to offer people an excellent quality of life with access to high quality employment, affordable housing and public services and sustained by reliable and effective infrastructure in terms of broadband, public transport and utilities"

(Welsh Government 2011b)

A policy instrument the WG uses to assist rural Wales is the European Union's Common Agriculture Policy (CAP) framework. Additional activities to improve the quality of life in rural areas are set out in the Rural Development Plan for Wales. During the period of study there have been two of these, each draws on the multiple departmental work currently underway across the WG. The WRO supported the WG on rural issues in Wales. Part of the focus was to help establish the success or otherwise of the WG actions under the RDP.

This thesis explores the capacity for representing rural statistics elsewhere within the main governance structures. This is considered important as amongst other things the Rural Development Plan 2014-2020 is imminent and the WRO no longer exists.

So to summarise the Programme for Government now forms part of the context within which data providers and data users operate. It is directly linked to top down and horizontal collaborative forms of governance in Wales. LAs play an important role in the latter. The Programme for Government has influence in how data is prioritized, collected and presented for Wales.

As spatial problems exist on multiple spatial levels national priorities may not always

coincide with local issues and local conceptions of what is perceived to be 'the make up of the area'. The distribution of information between national and local government has for some time been known to be problematic (See Oates (2005) on decentralization theorem). The difficulty being that there is a general asymmetry of information, local governments know local preferences, whereas central government does not, be that between the UK and Wales or between the WG and LAs.

4.2.2 Local Authorities in Wales

The function and structure of local government have been subject to frequent change (Cullingworth and Nadin, 2006). For example a two-tier system existed in Wales between 1973 and 1996. Since 1996, Wales has been administered locally between twenty-two unitary authorities. LAs range in size from the capital, Cardiff, with one-tenth of Wales' population, to small rural and Valleys authorities with fewer than 100,000 people. They include some relatively prosperous areas and others that are among the most disadvantaged areas in Europe. These authorities are responsible for providing the majority of government services to their local communities³⁷. The situation is slightly different in other parts of the UK for example England contains a mix of unitary and two tier counties and districts.

The WG sets the national priorities, strategic context and overall level of funding for services. It is then the responsibility of the twenty-two councils to deliver these services on a local level within the national context. However LAs are considered to be more than just providers of everyday local services. They must initiate and maintain community planning for their area, identifying long-term objectives for the social, economic and environmental wellbeing of the area, as well as objectives for contributing to achieving sustainable development in the UK (Welsh Government 2012). Therefore the mapping of social and economic statistics is equally important for developing local strategies.

Some LAs have developed their own 'data hubs', which allow officers to contribute and extract information about their LA area. There are also those that use GIS

³⁷ Services include: Community Safety, Education and Lifelong Learning, Environment and the Countryside, Housing, Leisure and Culture, Planning, Regeneration, Regulatory Services, Social Services, Transport and Highways, Waste Management (WLGA 2012)

software (e.g. MapInfo or ArcGIS) to independently map GI. This is often when data does not already exist locally or do not support all the datasets or types of analysis needed for community profiling. Geographic Information Systems are capable of layering multiple datasets on top of each other to explore spatial relationships, patterns and trends.

Spatial tools play a distinct role in planning, as each planning authority in Wales (including national parks) is required to prepare development plans. Local development plans are intended to provide a framework for rational and consistent decisions in order to deliver change (WG, 2013). The development plan process permits communities to be involved in preparing the plan and is designed so that communities understand where future developments can happen. As such most contain a key diagram or OS-based proposal maps.

LAs have statutory duties including, planning and transport, social services and promoting equality and sustainable development. They also provide a range of vital non-statutory services, such as leisure and culture and crucially the regeneration of local areas (WLGA 2012). They hence provide a range of services³⁸ and do so either directly or by commissioning services from outside organisations. Therefore there are services and functions that are discretionary, in that a council chooses to promote or provide something but are not committed to do so by legislation. They have the freedom to work within powers bestowed on them by various pieces of legislation (Local Government Assocaiation 2011). Therefore each has a certain degree of autonomy. As councils have the choice to organize their activities based on their responsibilities and there are a number of differing arrangements in Welsh LAs. Most have grouped departments in to directives in a similar fashion to the WG.

As part of their role LA councils collaborate with what are termed local partners (including charities, businesses, and other public service providers such as police and NHS) and residents to determine and deliver local priorities (Local Government Assocaiation 2011). LAs hence work closely with communities and other stakeholders, enabling them to respond to local needs and reflect local priorities in a way that would be difficult to achieve on a national basis.

³⁸ For example in recreation, environmental health, waste management, street cleansing, tourism, economic development, consumer protection, the enforcement of building regulations, litter prevention, provision of cemeteries, the issuing of miscellaneous licenses, dog control. They also have representative and consultative functions.

The Local Government Act of 2000 made LAs responsible for the economic, social and environmental 'wellbeing' of their jurisdiction and required each LA to also provide a Community Strategy for their area. The preparation and implementation of community strategies involves the LA and a wide range of organizations in the public; private; and voluntary and community sectors as well as local people (Lucas et al. 2003). This type of working proved so popular it spawned complexity and a certain degree of duplication in effort as partnerships formed anew rather than utilizing existing partnerships.

There have been a number of reports and reviews (e.g. Making the Connections (2004), Beyond Boundaries and Making the Connections (2006), the Simpson Review (2011), and the Williams Report (2014) that have sought to reform and reorganize local government and how the means by which it delivers public services in Wales (lorwerth 2013). They have focussed on citizen centered models, an ethos of collaboration, the simplification of partnership working, ensuring services are not constrained by political or organizational boundaries, and essentially reducing the amount of existing LAs.

This work resulted in the establishment of Local Services Boards and Local Services Agreements to promote joint working between public bodies. These are all being delivered under the banner of public service reform. Future collaborative working between public services in Wales is based around six collaborative footprint areas aligned with Local Health Board and Police Authority boundaries. These are shown in Table 4.4.

Table 4.4: Future LA Collaboration

North Wales – Isle of Anglesey County Council, Gwynedd Council, Conwy County Borough Council, Denbighshire County Council, Flintshire County Council, Wrexham County Borough Council

Gwent – Blaenau Gwent County Borough Council, Caerphilly County Borough Council, Monmouthshire County Council, Torfaen County Borough Council, Newport City Council

Cwm Taff – Merthyr Tydfil County Borough Council, Rhondda Cynon Taf County Borough Council

Swansea Bay – Bridgend County Borough Council, Neath Port Talbot County Borough Council, City and County of Swansea Council

Mid and West – Powys County Council, Ceredigion County Council, Carmarthenshire County Council, Pembrokeshire County Council

Cardiff and Vale - Cardiff Council, Vale of Glamorgan Council

The Williams Report (2014) has recently further recommended halving the current number of LAs in general. The wealth of data accumulated for LAs will now undoubtedly take backstage to these new alignments of units.

Local Service Boards

Local Service Boards (LSBs) have recently been established as a mechanism to simplify joined up working and oversee the myriad of statutory duties required at the local level but are not themselves statutory bodies. LSBs take a lead role to simplify partnership working whilst also steering the production of local strategies. They hence consolidate the work of existing partnerships and organizations that previously worked as distinct entities. Local authority councils retain a role in scrutinizing how services are delivered within their communities (Welsh Government 2012). Therefore an element of vertical governance still remains.

LSBs are responsible for developing Single Integrated Plans (operative from April 2013), which provide a framework for LAs and other public bodies to meet their statutory strategic planning responsibilities. They therefore aims to replace the previous statutory duties in terms of producing a Community Strategy, the Children and Young People's Plan, the Health, Social Care and Well-being Strategy and the Community Safety Partnership Plan, thereby reducing complexity and duplication, and freeing up resources (Welsh Government 2012). It is in this area that explorative mapping could prove useful as in producing single integrated plans LSBs have the responsibility of constructing a robust evidence base and require location-based information. As suggested by Welsh Government (2012) an effective local evidence base should focus on drawing insight and intelligence from information, rather than evidence gathering per se, and should satisfy both the short-term demands for

evidence to inform delivery and the longer-term demands around evaluating effectiveness and impact.

4.2.3 The WLGA and the Data Unit

The Welsh Local Government Association (WLGA) represents the interests of local government in Wales and promotes local democracy. The WLGA aims to improve local government and support authorities in the development of policies and priorities, which will improve public services and democracy. The WLGA is a constituent part of the Local Government Association and so links Welsh local government to the UK government (WLGA 2012). The WLGA elects a board of directors to run the DU. The DU was established in 2001 as a public sector, not-for-profit company in order to provide advice, guidance and support to local government in Wales around data and statistical issues.

The DU provides tools (such as InfoBaseCymru and its local variants) and training to assist local government in Wales. InfoBase Cymru was recently established (June2009) to provide small area statistic for Wales with the assistance of map based interface. The website draws on data from the Census and other key government surveys (e.g. Annual Population Survey).

InfoBase systems are therefore the DU's tool for providing access to a range of information for Wales. Themes include: people; economy; education; health; housing; environment; transport and community safety. It is a fully bilingual system and displays the data as maps, tables and reports. The system can be used to map data relating to these themes geographically for a range of spatial scales, including district, ward and super output area (SOA). InfoBase can be commissioned to work with LAs to build bespoke systems that support locally sourced data as well as that provided nationally by InfoBase (Data Unit - Wales 2014).

The DU has more recently produced mapping and data portals for Local Service Boards in Wales, named collective as LSB Insight. These tools hold core datasets and associated intelligence in a single place, which is kept up to date. These systems are intended to save time and effort locally and encourage consistency.

Clearly then local governance also requires a diverse set of social economic and environmental information to help them make decisions in many subject areas. It is also clear that sharing of this information is fundamental within these complex interorganizational relationships and collaborative environments.

4.3 Data Provision in Wales

Orford and Jones (2010) explain that as a nation Wales has been rather neglected in terms of small area mapping and analysis of social data. Partly due to its status as a government office region in UK national statistics but also due to a lack of detailed social survey data for small areas within Wales (with the decennial census of population being one of a few exceptions). This situation is not unique to Wales, the UK as a whole is starved of reliable small-scale social data (Orford and Jones 2010). The same could be said about economic data. This is partly due to the uncoordinated manner in which social and economic statistics have developed in conjunction with GI.

There are a multitude of spatial data providers in Wales. These range from the commercial providers, through the public and academic sector (some require license or a fee), to volunteered information. The majority of data are provided through the custodians website or via some form of data portal. The majority of information produced for Wales is released to the public domain using common levels of spatial aggregation for example Census geographies, administrative geographies, statistical geographies or other political or bespoke units³⁹. The three most encountered units are Unitary Authority (same as LA), Ward and Lower Super Output Areas (LSOAs) although occasionally information can be linked using postcodes. Several organizations host portals to access these spatial boundaries. For Wales these digitized boundaries for use with social and economic statistics can be accessed via a handful of main providers. These include the OS, the UK Data Service (contains what used to be UKBORDERS and CasWeb data portals) and EDINA (using DigiMap) but some of these services are exclusive to the academic sector.

In Wales, and specifically in terms of social and economic statistics for mapping, there are several key organisations that host public data portals. In terms of data providers, the majority of social and economic statistics can be found juxtaposed

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³⁹ A list of geographies is available at http://www.ons.gov.uk/ons/guide-method/geography/beginner-s-guide/index.html

between the Office for National Statistics (ONS) and the WG who produce National Statistics. The ONS is the government department that provides UK statistical and registration services in addition to planning and conducting the decennial census for England and Wales. It is also responsible for producing a wide range of key economic and social statistics, which are used by policy makers across government to create evidence-based policies and monitor performance against them. Most data are held in repositories that can be accessed via their neighborhood statistics and NOMIS data portals. The ONS has recently developed a Virtual Microdata Laboratory (VML). This is a facility for providing secure access to sensitive detailed data for statistical research purposes that serve the public good. Available data sources include business surveys, social surveys and Census samples. The information needs to be analysed in 'Safe Rooms' at various sites across the UK. Security procedures and specialist statistical controls ensure that the results that are taken away are safe from the possibility of sensitive details being disclosed (ONS 2013b).

The WG also has responsibilities for the production and dissemination of statistical information about Wales. This includes production, processing and dissemination of statistical information, for example in the areas of health, education, housing, agriculture, social care and the environment. The WG use a data portal called Stats Wales.

The Home Office, the Department for Work and Pensions (DWP tabulation tool), Land Registry, and the education sector, produce additional data as well as the Welsh Local Government Association (WLGA). The DU is linked with the WLGA as a data provider. Data sources include performance management systems e.g. Ffynnon, InfoBase, Administrative data sources e.g. benefits systems, Surveys (e.g. Welsh Health Survey), empirical academic research. Meshed within these larger data providers are a host of data observatories (e.g. the WRO, Public Health Wales) operating at multiple spatial scales on a variety of theme-based topics. These tend to aggregate existing data sources to their operational jurisdictions or produce bespoke data. Many of these organizations also host a range of spatially referenced qualitative data from interviews and focus groups. The ESRC funded UK Data Service⁴⁰ also contains much archived social and economic data.

Recently there has been an increasing interest in academic community in qualitative

⁴⁰ http://ukdataservice.ac.uk

GIS particularly within the social sciences. However spatially referenced qualitative data are difficult to quantify, and this is required for mapping purposes. Rather than trawl through existing collections WISERD, an academic collective based at Cardiff, have fashioned a data portal to enable access to these data and enable researchers to decide fitness for purpose. The WISERD Dataportal is a web-based software application. It aims to enhance users abilities to discover socio-economic research data by enabling meta-data searches using a variety of tabular, graphical and mapping devices. The goal was to encourage re-use and re-purposing of existing data (Fry et al. 2012). It is not limited to quantitative sources of evidence and can also discover qualitative interview data and mapping techniques enable users to explore the geographic source of the metadata and reveal where places are mentioned in its content.

The social and economic statistical base for policy decisions in Wales has been relatively weak with many large-scale surveys not producing large enough samples in Wales to provide reliable information. The WG began to address this issue in a series of initiatives that have boosted or extended existing survey work and targeting surveys to particular policy issues and extracting and adding value to administrative data sources (Quinn 2002). However the need to rationalise surveys in light of austerity measures has meant that some social and economic surveys have needed to reduce their sample size; reduce in frequency; lose content; or merge with other surveys using a common core of questions. The benefit of the latter is that the nation suffers less from survey fatigue (which would theoretically increase response rates) and enable cross-referencing between survey questions.

The availability of small area social and economic data is a concern for the future if statistical evidence is required to make decisions impacting rural Wales especially as the financial viability of a future UK Census is in doubt. Advances in surveying techniques and technology permit new means of data capture and enable increasing volunteered information to be made available.

Small Area Estimation (SAE) is demanded increasingly by researchers and policy makers who are seeking ever more spatial detail to their knowledge of populations so as to better guide the spatial design and targeting of interventions and resource allocations. Many approaches are available (see Figure 4.2)

The Welsh Government (2014b) have investigated an Iterative Proportional Fitting

(IPF) process for estimating small area data from social and economic surveys. They found that the technique could be used to estimate Middle Super Output Area (MSOA) statistics from surveys designed to be statistically accurate at the LA level. However it is questionable whether these instruments are currently developed enough to supply equitable data for population sparse areas and offer sufficient spatially disaggregated information required for local level policymaking.

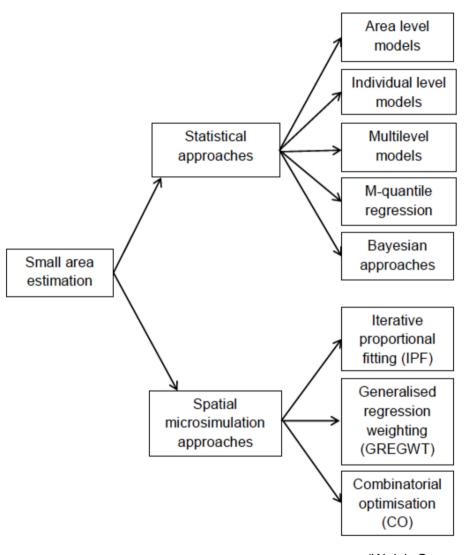


Figure 4.2: Techniques for Small Area Population Estimation

(Welsh Government 2014b)

4.3.1 Changing the Data Landscape - SAIL and the ADRN in Wales

In Wales the ability to link data at the household and even the individual level has become possible due to a research drive centered on health matters. The Secure Anonymised Information Linkage (SAIL) database at Swansea University was

developed by the College of Medicine. It receives core-funding from the National Institute of Social Care and Health Research (NISCHR) of the WG. The aim of SAIL is to utilize existing data on individuals and households held electronically and routinely collected and anonymised.

SAIL does not receive or mange identifiable data. This is because of the way the data flows to and from SAIL. The main identifying details (e.g. Name, Household Address, Birth date) are removed before SAIL receives datasets, and SAIL does not reconstruct the identifiable datasets. It builds on existing administrative data sources.

This process then requires the use of a third party. This third party removes identifying characteristics and creates a unique code for the individual. Anonymised data is then passed to SAIL who then have the ability link associated datasets about the individual. The process also permits linkage at the household level, in this case environmental factors can be added to each household (e.g. distance to a GP) and then this then linked as above.

As the databank became established it broadened it geographic range across Wales and has linked additional datasets. However to bring all this information together required a collected effort and a focus on developing several key areas. These included data anonymisation techniques, data acquisition methods, linkage protocols, data quality management, and appropriate analysis techniques. As this is one of the first 'Big data' initiatives in Wales many of these research areas are still in their infancy. Therefore raising awareness amongst key individuals and operational staff within governance networks in Wales is crucial to ensure data is collected and maintained in a format that is in a 'SAIL ready' format. As there are geographical components to most these datasets this presents a new arena for research and development – geo-privacy.

The ESRC has allocated 64 million to 'Big Data' initiatives such as these in the UK. As such a network has been established since late 2013 to coordinate activity and create several Administrative Data Research Centres. The Welsh component of the network will build on the work of SAIL and bring together a number of additional research bodies to incorporate all available routinely collected administrative datasets in Wales and also those collecting this information from elsewhere in the UK (e.g. ONS, DWP).

It is clear that the utilization of existing administrative data provides a future pathway for GI in Wales and the ability to link administrative data sources and store them centrally (such as those held in the SAIL databank) provides a resource that looks set to replace the Census. Although there is potential to expand the range of datasets available and the frequency of release, there are several issues that still require thought in relation to rural statistics. For example, despite linking at the individual or household level, exploration is still limited to fixed geographies such as LSOA. Although these are a significant improvement at demonstrating rural issues in comparison to the larger LA units, there is still potential for isolated pockets of deprivation scattered throughout Wales. Also many assumptions are hidden within these datasets and may result in false confidence⁴¹ in robust statistics. It would be interesting to contrast this type of output with the experiences of people in rural villages (e.g. would these people already know that 'Betty' has a certain health issue) to 'ground truth' and explore the qualitative experiences. This may reveal how much emphasis should be given to removing the exploration of policy relevant information at the household level. Although not fully captured due to the timing of this thesis an interesting research agenda is emerging to investigate the suitability of SAIL output in rural Wales.

4.4 The Emergence of Citizen Co-production and 'Big Data'

E-government continues to be a driving force for linking data securely and opening government data for boarder policymaking purposes. According to Saxby (2006) the e-government principles although not directly stated had implications for GI and subsequently GIS. Turner and Higgs (2003) suggest the culmination of these events has led to a firm recognition by the central government of the GI-sector and GIS gaining greater corporate significance in local government.

Government information changed from being regarded so much as a commodity and instead the concept of custodianship emerged, particularly due to the extent to which access to information underpinned key government policies for improving services delivery, and departmental cooperation (Craglia and Masser 2003).

⁴¹ Take GP registrations, not all people may choose to register and those that do may be of a certain disposition.

E government also instigated the UK GI strategy for integrating with wider EU GI policies (See Appendix A). Wales has its own GI strategy. However in Wales and the rest of the UK it is clear that there is a relative weakness in quantitative methods and GIS (Harris et al. 2013; Harris et al. 2014). This is clearly going to become more problematic as we move towards an epoch of 'Big Data'.

The impacts of the recession along with existing skill shortages and financial constraints presented barriers for local councils having to deal with initiative fatigue due to the unremitting plethora of new programmes and edicts streaming from central government (Cowell and Martin 2003). However a change in UK Government meant that another trend was emerging in which the general public plays an increasing role in decision making and service provision.

The advent of digitized information and web-connected databases in the age of social media, web 2.0 interactivity, and ubiquitous connectivity presented the government with no reason not to deliver highly personalized information to help inform citizens' personal decisions (Linders 2012). Shifts in the government-citizen relationship are based on the concept of "citizen coproduction," which has become more relevant and viable with advances in technology (Johnston and Hansen 2011). In this type of arrangement the government treats the public not as customers but as partners and this expands the role of the citizen from one of mere passive consumption of public services to one of active involvement to jointly tackle social problems.

Linders (2012) has usefully classified these new relationships in to three major categories: Citizens to Government (C-to-G), Government to Citizen (G-to-C), and Citizen to Citizen (C-to-C). He has provided examples of how this would operate in practice during design, execution, and motoring processes. Unfortunately this classification appears to assume that Government-to-Government issues have been resolved whereas in fact this still does not appear to be the case.

Some have criticized this development as being the government's excuse for withdrawing services at a time of austerity (Linders 2012).

"the Open Government Data agenda is also being used strategically, and often insidiously, by the UK government to fuel a range of broader and more controversial

policies, which are aimed at the continuation of the neoliberal form of state through the current crisis".

(Bates 2014 p. 394)

Braman (2006, p. 7) has suggested that it is important to "look where the light don't shine". Doing so enables a more nuanced appreciation for the influence of information policy on broader policy and societal developments. In this sense GI is becoming treated much like maps and their selectivity. Here GI is being controlled by UK policies, which have consequences for mapping in Wales. This shift also has clear implications for the use of GI and geospatial technology in government processes, particularly in terms of what counts as valid evidence for decision-making and challenges the role of the expert. Perhaps even more innovative techniques are required for example collecting data from consenting people going about their daily lives using GPS and mobile GIS apps to stream real time information about issues that are immediate and of most concern to the public. Perhaps then a real coproduced society can emerge.

Chapter Summary

So it seems that recently there has been a surge of effort to resolve the existence of data silos in order to avoid duplication of effort and essentially make evidence policy more cost effective. Cost efficient evidence is of even greater importance in the public arena during times of UK government austerity where welfare reforms are taking place in an unpredictable economic future. To help resolve these data provision issues efforts appear to have focussed on data portals to act as one-stop shops for issue specific datasets. In addition data linking technologies have been developed to ensure cross compatibility between websites using linked data. The term "linked data" covers a set of principles and approaches for publishing, sharing and linking data over the Web, in particular by using semantic web technologies. The logic for developing linked data and geoportals to synthesise statistical data resources is that such resources would be much more useful to researchers and policy makers if they could be linked up and explored as a single rich data landscape.

Now distributed GIS systems are able to access data (and applications) seamlessly and stream it in to a local system for display, analysis and representation. All that is

needed is knowledge of what has been termed a docking page or landing site (a place that contains all the links to GI) and an understanding of the logic between clients and servers. However the processes are not as straightforward as described, are reliant on metadata and require a new vocabulary and operational skills. The problem in terms of representing rural statistics remains in that although the processes of display are becoming easier (undoubtedly meaning more mapped rural statistics will enter the public domain) the underlying focus of collecting and matching data to existing administrative boundaries has remained unchanged. Herein lies part of the problem in mapping rural statistics, the simplest methods offering the least disclosure are not necessarily the most appropriate and can hide or distort rural issues.

An age of 'Big Data' emerging, if not here, and as such the current ways of understanding social and economic information need to become simpler and not more complicated but at the same time need to contain more information. They also need to become more reflective of people and how people live their lives. This requires a fundamental rethink of mapping practices, particularly for rural areas, where prior efforts have been exposed as misleading.

We are entering a new stage in the way we handle spatial data and join it together. Old methods and techniques are being revised and at the same time ushering in by a new generation of web based specialists who present options to enable the rest of us to interact in the worlds they create. In this sense this is also an opportunity⁴². The question now is how aware and ready are those currently mapping rural statics in Wales?

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⁴² This will be discussed in more depth within the conclusions.

Introduction

How geographical space is represented, what spatial information is represented and what space means in an age of advanced computer and telecommunications technology are all critical issues for society (Wilbanks et al. 1997, p. 39). Particularly as the resulting representations, by mapping out what is currently perceived as important (Harley 1989; Wood and Fels 1992), have the potential to influence how decision makers think about and interpret data. Mapping and decision making are therefore clearly intertwined, yet little research has explored this in practice or explored connections to particular forms of spatial information.

This chapter clarifies the design of the research undertaken as part of this thesis in an attempt to move closer to understanding these issues. It does so by following closely those people involved in the visual representation of rural statistics for policy making in Wales. By entering the private arenas where this takes place, this thesis aims to draw from the experiences of those closest to the action to uncover and raise awareness of elements that could potentially be improved for the future.

To explore these issues in this thesis, a methodology was required; however, developing a suitable methodology was not straightforward. The main reason being that it needed to be designed in order to understand - amongst other things - the methodologies of others and how methods are applied in practice.

5.1 Deliberating the Methodology

There are several ways of collecting and understanding information and finding answers to questions – research is one way. Even within research, choices need to be made in terms of how to progress. Choices are not just limited to how to study but also what should be the focus of the study. These decisions not only vary between disciplines but can also vary from within a similar discipline (Curry 2005). There can be several angles from which to view or know the world. Using spatial representations is just one, and even this has multiple components (illustrated in Figure 5.1).

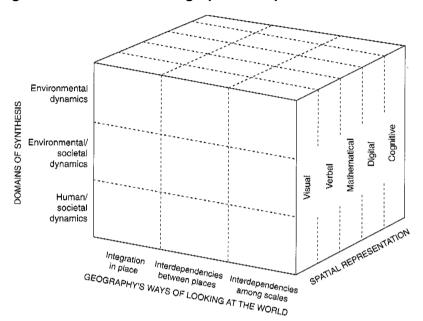


Figure 5.1: A Matrix of Geographic Perspectives

(Wilbanks et al. 1997)

The major difference between research and other ways of obtaining answers to questions is that in a process classified as research, answers become clearer through a framework of philosophies and methods that have been tested for validity and reliability (Kumar 2011). These are clearly important points to consider with regard to this research thesis on more than one level.

Firstly, this thesis has developed from a framework of philosophies and methods to respond to the research questions and, therefore, can be classified as research (at least that is the intention!). However, the topic of this research, mapping, is also a way of finding answers to questions. The difference is that mapping methods may not have necessarily emerged from the same philosophical framework applied in this thesis, to study it. A second point is that the policy making environments studied, as part of this research, may not necessarily rely on research-based evidence alone to make decisions. It is therefore important to outline this clear distinction, at this early stage, in order to detach the ontological and epistemological assumptions associated with the methodology used as part of this research thesis from the worldview of participants associated with the phenomenon under investigation. These issues will be discussed again later in the chapter in more detail, when outlining the philosophical ideas underpinning this thesis.

It is clear from the aims and objectives set out in Chapter 1 and the subsequent literature review that this study has a mapping focus. It is based on the concept of 'scientific visualization' and this phenomenon is investigated within the institutional contexts of policy making in Wales. In this sense, the topic of 'mapping' forms the bridge between theory and practice. Therefore, it is within this field of research that the precedents for an appropriate methodological framework should be found. However, much academic literature in this area appears geared towards software and hardware development, and improving techniques to be used within sociotechnical digital environments. Hence, the discipline appears to follow a largely technology driven path and has been, until recently, relatively inward looking. A consequence of such a narrow approach is that certain issues can remain untouched; pushed to the side or only explored from certain perspectives. Several authors have already noted the need for more practice-focussed research (Campbell and Masser 1995; Gill et al. 1999; Higgs 1999a; Maceachren and Brewer 2004; Dodge et al. 2009) and some have called for the need to look at the subject from alternative perspectives (Dorling 1991; Cosgrove 1999; Kingston et al. 2000; Kitchin and Dodge 2007). This type of research moves mapping practices into the spotlight from an insider's perspective. Ultimately, the research suggests that interactions and interpretations need to be understood between people and devices but also between people working within organisations and their networks. This investigation focuses on the people involved in mapping processes.

Previous research in the UK, despite being fruitful in offering software and techniques for scientific visualization, has rarely accounted it within specific mapping practices. Studies have not really gone beyond implementation as part of Geographical Information Systems (GIS) where it is translated as a process of diffusion. Rather than look at a systems-based approach, this research exposes how the visual components of these types of systems are manipulated in the workplace to resolve specific policy related problems acting between data and people creating a bridge between data enrolled in policy making and the majority of information that is not. Without this type of research, decisions and actions may have taken place, or are currently taking place, based on factors that are little understood and that have not yet been explored in a practical context. Therefore, the mapping actions and activities of individuals embroiled in these policy linked networks need to be understood and interpreted in order to understand and improve practice. There is something not quite right about how rural statistics are currently being mapped but what are the methods for uncovering this?

5.2 Qualitative Research for a Quantitative activity?

Within the last decade, several studies have departed from the scientific paradigm and began to incorporate qualitative approaches to study map use in a sociotechnical age. Suchan and Brewer (2000) note, for example, that research on map making and map use has recently broadened its mandate and as a consequence, researchers needed to incorporate a larger suite of methods and, like other geographic sub disciplines, use qualitative methods. Specifically on map making and use, they note that qualitative methods have the advantage of bringing the researcher closer to the problem solving realms of map makers and map uses in practice. This study mainly adopts qualitative methods because of the complex nature of the study. The study involves exploring different issues from multiple perspectives and with multiple representations for diverse audiences. This is without even beginning to consider the context (Chapter 4).

The complexity of the subject needed some sort of theory to enable these issues to be brought together using systematic but flexible methods for gathering information. Deeper understanding could then be developed through an interpretation of the explanations of people closest to the issue. Issues could therefore be uncovered, not through neutrality and distance from the object of study, but from immersion and collaboration with those involved in mapping practices in their own environments.

Previous studies have attempted to improve the efficiency of human computer interaction by attempting to make the representations mirror the real world, so as to be communicated effectively and efficiently and be understood by the human mind. At the other end of the spectrum, studies have tended to concentrate on broad structural perspectives of technological implementation within organisations. For example, the role of GIS within organisations (Campbell and Masser 1995); the link between people, organizations and GIS (Petch and Reeve 1997), and GIS diffusion in local government within Europe (Masser et al. 1996) and the UK (Gilfoyle and Thorpe 2004a) and Wales (Gill et al. 1999). This research aims to explore the liminal space (Moles 2007) left between these extremes, experiences in daily practice. A space worthy of consideration (Dodge and Perkins 2008).

It is important to reinforce that the topic of scientific visualization is not just confined to GIS; it is just a component of a GIS. The topic of scientific visualization is much broader than just GIS but both may be considered forms of mapping. Scientific

visualization technically represents the interface between humans and computer output for interaction. As such, what appears as missing from the aforementioned approaches are strategies that delve into the detail of these, often private, activities. Places where people interact with each other and these technologies to tackle specific issues. It is here, within the context of these institutions, and influenced by wider external networks, that the mapping of rural statistics takes place. It is here in offices that most evidence will be collected that can add detail to, and perhaps refining current theoretical perspectives. Awareness of previous methodological approaches to research provides insight into the issues but from alternative perspectives. These should not be discarded but instead used to position the researcher closer to the experiences of those being studied.

The complexity and multifaceted nature of the issues involved in this thesis has fundamentally led to the requirement of an issue specific theory. Mostly because scientific visualization research, until recently, has been developing in an *ad hoc* manner and has therefore been relatively uncoordinated in terms of a theory resulting in underdeveloped practice-focussed research. The lack of robust theoretical grounding, for understanding the actions of policy makers involved in the act of representing rural statistics and using the mapping outputs in these processes, is therefore key in determining the methodological basis for the study. In turn, this means that for the research questions of this thesis, inspired induction applied to exploratory, empirical research may be more useful than using deductive reasoning. Rather than focus on reductionism alone, this thesis aims to explore topic-relevant issues in-depth and account for them in their broader context to show that there may be more to the picture than first meets the eye.

5.3 Methodological Framework

Research is multifaceted with a number of key and common components. These commonly include an underlying research philosophy; a design that has the purpose of meeting objectives, and an all-encompassing research strategy set in place to move closer to an answer for a unique set of problems: the research questions (Creswell 2007). This section will outline and detail these components in order to justify the research logic and ensure the research undertaken as part of the thesis can be emulated in the future.

Foremost, the philosophical framework guides what matters in a research project. It is, therefore, important to discuss these ideas and how they have led to a research strategy and design that in turn encapsulated a suite of methods. So it is from the foundation of philosophy that choices have been made in terms of the specific aspects of fieldwork, data collection, analysis, synthesis and presentation.

5.3.1 Philosophical Perspectives

Hypothetically, if all philosophical questions were answered, there would not be much need for the multitude of research strategies that compete for acceptance in terms of explaining the social world. It is important to emphasise, however, that there are no definitive answers to philosophical questions, they simply relate to the different ways of thinking about the world and the different ways it can and should be studied. Nevertheless, it is important to engage with philosophy and the questions it poses as by doing so offers a lens into the different ways of the social world and the different beliefs about how in practice, it can and should be studied (Ritchie and Lewis 2003, p. 15). Linking research with these philosophical traditions helps illuminate the special characteristics of different research orientations (Merriam 1998). Therefore, philosophical interpretations of reality will set you on a certain research pathway.

When questions about the nature of reality and its basic elements are asked, it is termed 'ontology'. Exploring the nature of knowledge and how it can be acquired is termed 'epistemology'. The methods of enquiry set in place to access the data required to produce this knowledge is termed the 'methodology' (Denzin and Lincoln 2005). These components are related in many ways and on many levels. The net in which these ontological, epistemological and methodological assumptions are entangled has come to be thought of and known as a paradigm or worldview (Guba 1990; Creswell 2009). Despite its increasingly common use within the social sciences, 'paradigm' is not an easy term to define and has been used in a variety of ways. Guba (1990) suggests that this is not problematic and actually enables the term to be refined, as the understanding of its many implications improves. However, it does lead to alternative terminology often being used interchangeably throughout the literature which are suggested to have the same underlying meaning (Crotty 1998).

Paradigms - those past and those currently emerging - are often characterized by the way their spokespersons respond to ontological, epistemological, and methodological questions. A paradigm can, hence, be thought of as a basic set of beliefs that guides action in inquiry or research (Guba 1990; Guba and Lincoln 1994). This is a very basic definition but serves to illustrate that the way we think and come to know that our world can change over time (Kuhn 1962).

Over the course of time, a number of paradigms have competed for acceptance, for informing and guiding enquiry in the study of human activity. Denzin and Lincoln (2011) have attempted to classify these paradigms into the following: Positivism, Post positivism, Critical theories, and Constructivism and Participatory Action Research. Quantitative research tends to be associated with positivism or post positivism and qualitative research is associated with the other paradigms. Qualitative research itself tends to be split in terms with how it deals with the agency of knowing beings and social structures.

Refinement, additions and alternative groupings have been made to these basic classifications in the literature as well as the introduction of alternative terminology. This lack of consistency is perhaps due to the complexity and abstract nature of the underlying philosophical ideas resulting in 'fuzzy' boundaries that are not tangible. May (1993, p. 10) describes the 'fuzzy' areas between philosophies as 'the muddy water' and explains that there have been many attempts to build bridges between perspectives. The purpose of outlining the classification, here, is not to promote the acceptance of one paradigm over another but to acknowledge that there is more than one paradigm competing for acceptance in social enquiry. As a result, researchers and those researched can hold different worldviews and have various ways in which they can acquire knowledge and instruments to use for obtaining this knowledge.

Paradigms from which research flows can impact the theory and method selection and can therefore often supersede methods in determining qualitative enquiry from quantitative approaches (Denzin and Lincoln 2005). Although paradigms and methods have a connection, the links are not straightforward. The use of any strategy to perform research does imply an acceptance of a certain paradigm. In practice, quantitative methods are generally associated with the positivism paradigm but can form part of a mixed-method strategy. Qualitative methods can be found within an array of paradigms; in fact, qualitative research can even be positivistic in

its assumptions about ontology, epistemology, and methodology (Creswell 2007, 2009).

The philosophical questions posed within this thesis are complex and multi-layered, especially due to the degree of reflexive thinking required to proceed with the research. Essentially, a lens has been placed on what is a quantitative method rooted in the natural sciences and nurtured through experimentation and influenced by the positivist and post positivist paradigms. Critical approaches have responded by providing insight but have offered little in terms of improving daily practice. Using a qualitative perspective in this research aims to utilise research strategies to explore this issue and restore balance to research output in this field by offering organisations sensitising devices for pragmatic reflection.

This research moves away from the positivist stance (commonly summarised by a conception that reality is fixed; 'real', independent of human understanding and knowable) and acknowledges that reality is only somewhat apprehensible. In doing so, ontological assumptions have been made about the nature of the world and what we can know about it. While acknowledging the role quantitative methods can play in research, this thesis draws more from the qualitative toolbox to expose quantitative practices as interpreted from the perspective of those living and working with them. Looking through the interpretive lens enables this thesis to challenge the ontological security of tools and methods emanating from this discipline to represent rural social and economic statistics. To do this there is a need to reflectively follow individuals and their activities and roles within policy making networks. Further justification for this juxtaposition and layering of epistemologies and methods can ultimately be found by reflecting on the research questions posed. These questions require rich descriptions and explanation; tasks difficult to achieve by amassing numbers, formulae and experiments alone.

Finally, as this study focuses on a relatively small subsection of people found within a handful of organisations, statistical generalization of any quantitative-based approach alone would be questionable. Arguably, the contexts within which generalization would have been extracted provide a more important and interesting role in helping to explain agency and action. Although not used directly, the ideas linked with quantitative information and methods form a large part of this thesis, and are not considered to be incorrect, but are investigated at arm's length through the interpretations of the researcher and the research subjects. Neither perspective is

privileged but the goal is to academically explore the issues from a qualitative standpoint.

This thesis adopts an interpretive approach and by doing so acknowledges that researcher and the social world impact upon each other, and that although every effort in this research will be made to be as objective and value free, it is fundamentally unattainable. It is the belief that the social world is not to be governed by law-like regularities (as would be expected in the discipline of physics) but is mediated through meaning and human agency. These are the principles that guide this thesis. These social worlds will, therefore, be explored and understood using the participants and the researchers' understandings and experiences. Deeper insights into the problem are then possible through synthesis, interlocking and comparing the interpretations of respondents (Ritchie and Lewis 2003). This methodology focuses on the agency of individuals (map makers and users) and considers how they affect and are affected by structures (that form policy making arenas) and social networks (See Appendix B). These theoretical concepts are considered in the next section, as they have a role to play in how fieldwork was practiced.

5.3.2 Matching a Research Strategy to the Research Questions

The general principle is that the research strategy and the methods/techniques employed must be appropriate for the questions you want to answer (Robson 2002). The choice of method should not be predetermined, the method should be most appropriate to what you are trying to find out (Silverman 2005). The research questions of this thesis have been guided and shaped by the literature (and the gaps within it), with the research strategy then molded in a design to accommodate these questions.

This thesis explores how scientific visualization is being incorporated as part of mapping processes during the policy making activities. In particular, it aims to reveal how mapping is conducted with social and economic statistics when representing population sparse areas. The underlying argument is that the process of mapping rural statistics is different to mapping population-dense areas; not least when it comes to their representation, but also when it comes to realizing the consequences in practice for policy making. These are topics that have been under researched. The application of a constructivist grounded theory (Charmaz and Belgrave 2002) will help reveal using an abduction logic (Blaikie 2000) with a final use of reflective

retroduction to help explain findings in order to guide future research. As such these are seen as complimentary tools.

For these tools to be used, questions need to be asked, such as how and to what extent do policy makers account for these representational issues in order to make informed decisions? What are the limitations and benefits of mapping with rural statistics? How are different forms of scientific visualization employed to display rural statistics and why, and in what contextual circumstances? How and why are new technologies introduced for representing social and economic statistics and what are the consequences of their introduction in terms of the representation of rural statistics for policy making? How are all these decisions, definitions, influences juxtaposed and negotiated within this arena and what can be done to improve the representation of rural social and economic issues? These ideas have led to the development of the research questions of this thesis, shown in the box below:

Research Questions

- What are the benefits and limitations of scientific visualization for policy making?
 - What factors limit the scientific visualization of rural statistics for policy making and how could this be improved?
- What has happened in Wales since the Chorley Report with regard to the use of GI and geospatial technology?
 - How does this affect the ways in which rural statistics are produced, understood, stored and communicated and contested?
 - How reliant is mapping on technical and social factors?
- How are maps currently used to represent rural statistics for policy making and planning?
 - O Why is mapping used?
 - How does this vary between and within organisations?
- How are the current dynamics of mapping changing in Wales?
 - What role do data custodians now play in mapping rural statistics in Wales?
 - How can mapping affect communication and decision making within collaborative environments?

According to Yin (1994), the purpose of most case study researches is to answer the why and how questions, as detailed above. However, they are not limited to these types of questions, in fact case studies can report about a variety of specific workplace situations or events and describe who, what, where, when. In addition, they can be targeted at a small number of events to reveal how relationships are formed during these interactions and why. It seems that the use of a case study design can be used to align the research questions posed in the research strategy. It can act as a framework in order to manage activity and ensure an element of academic rigour is maintained.

Questions still remain in terms of how to exactly approach questioning, what exactly is being questioned, and from whose frame of reference (etic/emic)? To explore this further, it is necessary to be clear about the distinction between what November et al. (2010) refer to as the 'mimetic traits of maps' (how maps are expected to mirror nature) and how they can be used to navigate actors between relevant elements within the map. With reference to this thesis, the former refers to how appropriate maps are at representing rural statistics to reflect 'real world' conditions. The latter is about achieving a level of parity in terms of the elements represented within the map for interpretation. In the first scenario, the void between 'nature' and science and technology is vast and requires a 'leap of faith'; whereas, the void between how elements appear within a common representational platform requires less the leap of faith and more the building of a bridge. Therefore, it is the qualities of these common platforms as a consequence of collective actions that will be assessed. Rather than looking for intrinsic qualities of claims made based on the scientific visualization of rural statistics, it will be the transformations that occur as they are applied in practice that will be of interest. It is the interpretation of these mapping processes, from the perspective of participants, and how this can alter processes of interaction that is of interest, not attempting to work out how best to mirror some external 'nature'. Therefore, it is important to focus on how and why resources become enrolled around these representations and how they become associated with other actors and resources.

Linked to the previous point, it seems that to follow this line of questioning requires this research to follow from what appears to be a different strategy to those studied. Hence, a further differentiation needs to be made between the research strategy of this thesis and the potential research strategies of those under investigation. The interpretive paradigm from which this thesis flows has resulted in a particular take on

how to study policy makers and their application of visualization for rural statistics. This has ultimately resulted in the theories' design and methods of this thesis. This strategy may be opposed to the worldviews and strategies of those being researched. Moreover, the worldviews of these actors affect how their own objects of research (such as people living and working in rural Wales) are accounted for in policy. A methodology (context of the researcher) is being used to study methodological processes (the object of the study). Giddens refers to this phenomenon as a double hermeneutic.

In this study, it is the internal factors within the case and the variation between actors that are privileged, and these elements are the focus of this research. It is therefore important to highlight that the paradigms of the researcher and the researched need not agree in practice or research. This is not a problem; it is in fact what is interesting and enables this research to potentially guide future practice. The importance of the paradigm here, for the researcher, is to move closer to answering the questions of this research thesis. The importance of methods for those being researched ultimately affects how rural people are considered within broader policy frameworks. It is here, during these activities, where further consequences are likely to arise for people living in Wales, as these activities can influence public resources.

Pragmatically, this complex situation requires a research design that can explain the meaning of social phenomenon in a natural setting using an approach that can accommodate a range of issues that culminate at the interchange of paradigms and methods. Through adopting a case study design, this research thesis should be able to account for representational issues as well as a wide range of other factors emanating from organisations and wider networks.

Stake (2005, p. 449) notes that the contexts of the case, whether they are social, economic, political, ethical, or aesthetic, are important to consider, and they "go a long way toward making relationships understandable". The researcher must be "ever-reflective", considering impressions, and deliberating on materials and recollections. This research thesis aims to form part of a self-reflexive process of enlightenment that has the potential to ultimately produce action in the 'real world', in terms of improving the visibility of rural social and economic issues so that they can be accounted for by government policies. It will do so by offering sensitizing devices to assist theoretical reasoning for practice.

5.4 Organising Theory with a Case Study Design

The research undertaken as part of this thesis follows a case study design to focus and organise the logistical elements of the fieldwork and to keep the research manageable. Case studies are well-established in qualitative enquiry (Yin 1981, 1984, 1989, 1993, 1994; Merriam 1995; Stake 1995; Merriam 1998; Stake 2000; Yin 2003a, b; Flyberg 2004; Yin 2004; Stake 2005; Creswell 2007; Yin 2009).

According to Yin (1994), case study is defined as:

"...an empirical enquiry that investigates a contemporary phenomenon within its reallife context; when the boundaries between the phenomenon and context are not clearly evident; and in which multiple sources of evidence are used."

(Yin 1994, p. 33)

This definition is fitting in terms of the context of this research as visualization of rural statistics is a contemporary phenomenon and occurs in working environments of certain actors in the policy making arena; however, the extent to which functions in practice is not clearly evident. In addition, due to the complexity of issues involved, multiple sources of evidence will be required to reveal many of the often hidden processes and interactions that result in decisions being made regarding rural Wales.

Researchers have applied the case study research method for many years across a variety of disciplines. Case study approaches have been applied in the social sciences, as well as in practice-orientated fields. Case study research has been used widely in business, education, psychology, sociology, political science, social work, community planning and economics (Dooley (2002); Merriam (1998); Yin (2009)). Case studies are particularly relevant for undertaking research within organisations where the intent is to study systems, individuals, programs and events (Swanson and Holton 2005).

Although a case study design was decided upon to structure the fieldwork for this research, it was not necessarily a means to an end as a myriad of pathways were available from which to proceed. According to Merriam (1998), case studies can be particularly useful for studying a process, program or individual in an in-depth, holistic way that allows for deep understanding. Merriam points out:

"A case study design is employed to gain an in-depth understanding of the situation and meaning for those involved. The interest is in process rather than outcomes, in context rather than a specific variable, in discovery rather than confirmation."

(Merriam 1998, p. 19)

This definition suggests case studies are compatible with an actor-orientated approach to investigate visualization practice as they target meaning from the perspectives of those involved and can be used to discover and follow processes from within their own personal context.

Stake (1995) directed attention to the case as an object within a bounded system and suggests learning all of the case out to its boundaries; tracking its issues and pursuing its patterns of complexity. Stake (2000) focuses on case study as a choice of what is to be studied - noting that regardless of method, we choose to study the case. It seems therefore that to pursue a case requires clear definitions of what should be studied and to what extent.

Using a case study enables research to focus on a 'bounded system' or case whilst utilizing informative and contextual data to interpret findings about the phenomenon explored. According to Creswell (2002, p. 485), "'Bounded' means that the case is separated out for research in terms of time, place, or some physical boundaries" In other words, it is possible to create limits around the object to be studied. The research object of the 'case' can be individuals or organisations, interventions, relationships, communities, or programs and the case approach supports the deconstruction and the subsequent reconstruction of various phenomena (Yin 2003b).

5.4.1 Case Bounds

In this research, the case under investigation is bounded for the purpose of study in several ways. The phenomenon under investigation is the representation of rural statistics and, therefore, the actors that interact in this arena form the immediate focus and it will be the experiences of these people, within and amongst organisations, which will be tracked. In terms of timing, the case is associated with the introduction and roll out of InfoBase systems throughout Wales at a local level and the release of the Census 2011 statistics. As such, this research explores what Latour (1987) terms 'science in the making'; it follows a selection of actors who make sense of these systems and processes as they become enrolled in policy making

and are used for representing detailed spatial statistics. Further, the context for the case is contextually bound within post devolution policy making in Wales because until devolution there were little comprehensive studies of the Welsh countryside; particularly, there was a lack of baseline data (Wales Rural Observatory 2004). The creation of the NAfW and the WG enabled rural social and economic conditions to be considered as a distinct policy area. In terms of physical bounds, rural Wales is bounded within the political territory of the WG in Wales; the organisations under investigation also fall within this jurisdiction. Interpretation within these bounds should lead to a deeper understanding of meanings attributed to situations by those involved that would otherwise be difficult to assimilate and understand.

Although these criteria bound the study pragmatically, if issues arise that fall outside the bounds of the case and are deemed important (e.g. Chorley Report) they will be included within the investigation. To illustrate the point, although other parts of the UK and the EU are essentially beyond the bounds of this research, as outlined above, it may be important to consider the role they play in terms of the decision making within the case study of Wales. It may be that these factors act to control local elements of the network from a distance.

5.4.2 Criteria for Case Selection

Cases can either be single or multiple but must capable of reflecting the research questions of the thesis. There can be multiple case studies or case studies embedded by multiple cases (Yin 1994, p. 39). In order to address the research questions, multiple cases have been examined using policy-making and planning organisations as the basic unit of analysis⁴³. These are embedded within a holistic case study in Wales. For each case, individuals were sought who were likely to have the relevant experience in mapping social and economic statistics for rural areas.

The selection of the cases was based on a number of criteria. Firstly, situations were examined in which an organisation would be regularly collecting and presenting data that covered rural parts of Wales for the purpose of making policy related decisions. These included county and county borough councils in Wales and the WG. As the DU was in the process of rolling out local InfoBase systems for policy purposes throughout Wales, it was also included as a case with the aim of providing a rounded

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⁴³ Only those with a core role in providing social and economic statistics or coordinating other that do in population sparse areas have been prioritised - hence certain omissions e.g. National Parks.

study. Hence, this research functioned as an opportunity to capture the transition towards using these data-portals as a mechanism for representing as well as capturing locally specific methods for representing rural statistics using desktop GIS or an alternative.

The cases that were selected to scope the current situation in Wales were Powys County Council; Carmarthenshire County Council; Gwynedd Council; Isle of Anglesey County Council; Conwy County Borough Council; Monmouthshire County Council; Vale of Glamorgan Council; Bridgend County Borough Council and Caerphilly County Borough Council. In addition to these LAs, the DU Wales, an independent organisation within the local government family in Wales and the WG, were used to add to these cases. As multiple cases were conducted, it was important to follow replication logic in order to collect evidence in a way that was transferrable across cases.

Secondly, it was my intention to look for cases where explanations required – at least at first sight – looking at processes and mechanisms with multi-scalar implications and with a high relevance for the workings of policy making in Wales. This was in order to understand the myriad of processes; regulations and interests that determine the situation seen by the fieldworker.

In addition, to avoid falling into a thorough empirical description that would not be useful beyond these particular realities, it was important to find out what contextual factors mattered most. To do this, it was essential to look for cases that were full of context. In this way, it would be possible to further theoretical knowledge about the visual language of policy making in Wales. This could then be used to help understand the broader mechanisms that were leading to the digital re-emergence of maps in multiple areas of policy making. The case studies therefore had to suit these purposes.

The case study involved multiple cases and was also set out in multiple stages; therefore, it was longitudinal in nature. Therefore, there was an ongoing process of data collection based around two major waves of fieldwork.

Initially, each case was contacted to help scope out the situation in Wales and this led to an ongoing process of learning and refinement of concepts and ideas. Following this, a second stage of fieldwork was scheduled. It was performed in a

more targeted manner to explore some of the emerging concepts in-depth but also to witness specific examples of mapping in practice. This second wave of work also coincided with the release of census data; hence, capturing a moment in time when statistical activity, in theory, should be at its maximum. In addition, the Rural Development Plan for Wales was in the process of gathering social and economic data to steer its formulation. Repeat case visits provided participants with an opportunity to reflect on the intervening period, and comment on their activity in light of what was initially discussed.

5.5 Conducting the Research

The framing of this research takes a mixed-methodological approach. In other words, numerous methodological traditions inform this research in order to enable the researchers to inquire into the questions. Considering the term, *paradigm*, the framing of this research is written within the constructivism paradigm using interpretative epistemologies. The dominant discourse is that research needs to follow a rigorous, set plan, and choose a single methodology. The challenging discourse, enacted within this research, is that the plan, questions, and methods emerge through the interaction within the research context. Multiple theories are employed to turn the lenses on the inquiry. The theoretical framework for the research has already been detailed; next, the collection of empirical data is outlined and discussed from the fieldwork practice.

Stake (1995) and Yin (1994) identified at least several sources of evidence that could be used within case studies. These include, but are not essentially limited to, documents, archival records, interviews, direct observation, participant-observation, and physical artifacts. In terms of this research, maps often represent the product of mapping practices and therefore were available in documents and often available online. There were also printouts and historical records.

It was possible for working environments to be assessed through direct observation, and the private processes of geovisualization witnessed through participant observation. It was decided that interview techniques were capable of detailing the perspectives of those closest to mapping activities.

Construct validity was maximized through the use of multiple sources of evidence logically linked through the duration of the investigation; combining evidence from multiple cases and continuous content reflexivity through discussions with key informants and the research supervisor.

5.5.1 Preparation for Data Collection

In preparation for the collection of data, there were a number documents that needed to be produced. The first, and arguably the most essential component, was the study protocol. This document served to structure the multiple voices and perspectives of actors and the interactions between them. The protocol contained an overview of the project; field procedures and a database of contacts; an interview schedule containing themes to recall during data collection and an outline and format of the general report. The database of potential contacts and their access details needed to be constantly updated and linked to background documents gathered during earlier stages of the research. This database was used to personalize covering letters and emails sent out in order to request participation in the research project and, if necessary, to pursue actors with reminder phone calls (Examples are provided in Appendices C – D). Appropriate equipment also had to be secured, such as digital recording devices and transport.

The approach taken to fieldwork may be considered ethnographic. A bounded population was studied and inquiries made about how they act during their day-to-day working lives and the meanings they attribute to these experiences. However, the extent of the boundaries were explored and elaborated through discussion and following actors and their networks. The key was to explore situations in their natural settings by playing the role of participant observer. Obviously, the researcher's inclusion within these settings creates somewhat of an artificial environment but through establishing rapport and trust with participants within these networks disruption can be kept to a minimal. In this sense, the research will be observed from an academic standpoint but will use shared knowledge and experiences from practice to move deeper into the actors' environments. In keeping with the actororientated approach, the principal research method is the interview.

5.5.2 Interviews as a Source of Evidence

Interview scripts were developed based on the conceptual framework developed

during the review of literature. These were not overly structured, enabling many of the themes to be transferable between organisations; however, small adjustments to some questions wording were required in order to account for the differences between organisational structure, e.g. central and local government.

The interview script enabled the collection of personal information about the interviewee such as name, a description of their role in organization, and previous experience of mapping. It also collected information on the variety of mapping practices used and their purpose (explorative through to presentation) and awareness of available techniques, technological change, collaboration and the networks of interest, use and knowledge of InfoBase Cymru, awareness of statistical and representational issues, geo-privacy, issues linked to the Chorley report (e.g. data availability, interoperability, training, etc.) and working examples of representing rural statistics for policy making (for full details see Appendix D- F).

In terms of the place of interviewing in social research, it is at the most fundamental a method for generating conversations with people on a specific research topic or range of topics with associated interpretations by the researcher of the resultant data. Interviews can, hence, offer insight into people's biographies, experiences, opinions, values, aspirations, attitudes and feelings (May 2011). So it is through the interview that an explanation of why and how mapping activity for policy can begin to be understood.

An organisation does not perform mapping and likewise it does not create a map; it would be an individual or collective of individuals who may or may not work for that organisation. The collection and balance of these people does have an important role to play. Those working for an organisation are reliant upon it for employment and become enrolled within its culture and rules. As such, they become affected by the cumulative actions within and between organisations. Nevertheless, even these factors can be understood through what interviewees have to say on the matter. Interviews bring us closer to the agency of individuals and their network of associations: those closest to mapping activities. It is here where barriers to regular practices can be understood and where maps are made locally and from a distance.

May (2011) suggests that there are four main types of interviews conducted in the social research. However, the bounds and mixing of these can vary dramatically based on the research questions. For the purpose of this research, the interviews fell

somewhere between what are described as the 'semi structured' interview and the 'focussed' interview. Several group interviews were also conducted, enabling group dynamics and norms around issues and topics to be explored. What was emphasized in each case was that each interviewee should answer topics provided from their own perspective.

All interviewees were encouraged to respond in an open-ended manner to all of the topics. Interesting points linked to the literature were probed and explored for more detail. The aim was to encourage response from the interviewees' own frames of reference and minimize the preconceptions that may be brought to the interaction. This encouraged qualitative depth by enabling interviewees to draw upon ideas and meanings with which they are familiar. This provided a greater understanding from the actor's perspective, situated within their networks of associations. Divergence from the subject was seen to add something about their forms of understanding of the topic (Bryman 1988). This method can, hence, be considered better at gaining reflection on ongoing processes.

Interviews were semi-structured in so far as a core set of questions were held constant to enable comparison of similar themes between actors and because a selection of pre-determined examples of mapping activity were provided for graphic elicitation. Graphic elicitation involves presenting interviewees with a diagrammatic representation of the domain with which they are involved. This may provoke comment on the details of the diagram and the conceptualization inferred from it, in addition to prompting further discussion of the domain in general (Crilly et al. 2006). This will be discussed in more detail within the next sub-section.

Ultimately, the semi-structured elements acted as nodes within the interview as would the questionnaire act as a node for accessing information from within the network. These were intertwined amongst unstructured elements that enabled each actor to discuss issues and specific problems when mapping rural statistics from their own perspective. All these elements were combined within an overall focussed and in-depth interview format.

Interviews remain unstructured in terms of the interviewee being allowed to consider and explore questions on their own terms but contained elements of order from the structuring around themes and by providing a selection of pre-determined visual representations for discussion. Setting out the interviews in this way enabled the range of factors that influence the mapping of rural statistics to be discussed from the perspectives of actors producing evidence for policy making. The design also helped define and elicit the relationships between these factors.

5.5.3 Graphic Elicitation

Crilly et al. (2006) explain how visual elicitation stimuli are artifacts employed during interviews where the subject matter defies the use of a strictly verbal approach. In this case, it was exemplar images of mapping activities.

Such stimuli might typically include physical specimens, maps, drawings, photographs and video clips (Banks 2001; Johnson and Weller 2002). The approach may elicit ideas that would otherwise remain unarticulated and hence promotes a deeper and well-balanced general discussion (Gaskell 2000). According to Törrönen (2002), this is because such stimuli bring factors external to the interview situation into view. They are useful for prompting response to "not now" moments; "not here" events and "not present" actors. Therefore, diagrams can provide a common conceptual foundation upon which discussion can be orientated and therefore improve communication with and between actors. The purpose of using visual elicitation has been to improve conceptualizations of the domain and provide a strong foundation to base future theorizing activities.

A stimulus interview has roots in constructivistic approaches and semiotic traditions. In it, language, representation and communication are not seen as sources of error for biased knowledge. Rather, they are understood as the necessary constituents of interaction (Törrönen, 2002). As such, graphic elicitation comprises a valuable component in a wider qualitative research methodology (Crilly, et al., 2006).

A selection of the visual stimuli for graphic elicitation for this research was chosen based on broad themes in the academic literature. The main source being Slocum (1999). In his book of thematic cartography and visualization, the author breaks this subject area into a number of distinct sections of application. These were synthesized and then further classified into broad groups that could be exemplified by visual stimuli. These broad groups were chosen to mesh with the aims of this thesis and the previous literature review of policy documents in Wales. The categories chosen were: Graphical data (the sort that could be produced in common spreadsheets or databases); Choropleth maps; Dasymetric maps; Cartograms;

Internet mapping portals (including examples of data classification and dot mapping); Web 2.0 maps (such as Google maps) and virtual environments for animation and multimedia. The codes and visual stimuli included within the interview are presented in the Appendix F. Not only were these graphics used as icebreakers and to elicit information, but also they served to provoke discussion about what may have been omitted (purposively or otherwise) from the study.

According to Törrönen (2002), any visual stimuli used during an interview should be applied as a resource in order to guide the interviewees to interpret the stimulus in the intended way. He suggests that this can be done in three ways: as clues, microcosms and/or provokers. As previously outlined, visual stimuli were used in interviews for this thesis as microcosms (icons). In semiotics, an icon means a sign which represents the object by imitating it (looking, smelling, sounding, feeling or tasting like the signified) (Fiske 1990). In this case, the icon produces the object selectively through raising only some of its specific features to the foreground. This can make visible and concrete invisible feelings and layers of reality by bringing them into the sphere of mimesis (Törrönen, 2002). When used as microcosms, the interview questions are built so that they encourage the interviewees to compare their own conceptions and experiences to the world constructed in the visual stimulus. Used in this way, the interviewees are channeled to mimetic action; to identify and interpret whether the visual stimulus represents the phenomena under examination truthfully and credibly. At the same time, data can be obtained to describe the manner in which the interviewees position and identify themselves with the situations, processes and/or actors in the visual stimulus.

Graphic elicitation was used during the first stage of fieldwork and was included as part of each interview to provide a common platform to contrast the views of each actor within the network.

5.5.4 Ethical Considerations

There were a number of further ethical considerations that required consideration prior to commencing fieldwork. First and foremost, it was important to be honest and open with all those involved in the research. For example, all those who participated directly in the research were told a broad outline of the research and its aims and were asked permission to be interviewed. This was after all case study research and not espionage; there was no intentional subterfuge.

Access for interviews was gained by writing to the participants; by telephone calls or through personal discussions with those met during research. At times, certain organisations were helpful with establishing additional contacts, by making suggestions and introductions: the DU, for example. Most individuals were happy to participate in the research and refusal was met on only a small number of occasions and tended to be through lack of response than by outright refusal. It was acknowledged that, at the time of study, the public sector was under considerable staff and resource stress as an indirect consequence of the recent financial crisis that began to take hold of the UK economy in 2007.

Before proceeding with each interview, the participants were aware that their inclusion in the research was entirely voluntary. The extent to which anonymity could be provided to the individuals was also outlined. It was important to raise this issue because there was a possibility of dealing with sensitive data that could, for example, portray individuals in an unwanted way to their managers. All interviewees were assured that all people in the research would not be named directly and would go under either pseudonyms or organisational acronyms. It was hoped that this reassurance would put the interviewee at ease and encourage more full and honest opinions, particularly with regard to research questions containing sensitive issues related to their own organization. Conducting interviews in a quiet meeting room, when possible, also helped.

Anonymity was offered; however, it was understood by all parties that because there were only a limited number of people in Wales working in these roles, then the person's identity might be inferred from the organisational name alone. This was problematic but it was felt that this issue was unavoidable and could be dealt with at a later stage in terms of presentation and writing style to contend with any sensitive content attributed solely to an individual spokesperson. Finally, to ensure the ethical issues were accounted for during each interview, the interviewee was asked for their consent to be recorded using a digital handheld Dictaphone. Interviewees were also told that they were free to terminate the interview at any stage.

The majority of field research was conducted in the working environment of policy makers. Whilst each organisations working environments provided useful context for the study, it was decided that the actual interviews, where possible, should be conducted at a specified meeting room or desk, in relatively quiet environments. This

proved important to ensure clear recording of the interview and a degree of privacy for the exploration of more sensitive issues.

5.5.5 Reflexitivity

Through entering into the network, this research project has an effect on the process under study. During discussions, for example, this research has increased awareness of rural statistics and how they may need to be considered. In the wider scheme of things, this was unlikely to change the overall course of action in terms of evidence-based policy making in Wales. If this research project were to have an impact, it was likely to encourage those involved to think about issues that they may have previously taken for granted.

In terms of accounting for the responses of interviewees, this will be done as objectively as possible, although acknowledging that this goal can never fully be met. Where it thought to be useful; to provide subjective perspective to an issue from personal experiences, it will be differentiated within the text so as to be obvious to the reader.

Engaging with actors ethically within policy networks in Wales enabled the research to move deeper in to the institutional settings within which these actors participated and enabled meaning to be attached to elements previously only identifiable as concepts or ideas. Moreover, by ethically following the actors during fieldwork this helped with the ongoing development of the research, theoretically as well as practically.

With all this in mind, transitions were made from theory and preparation, to practice. At this stage, it was necessary to step deliberately and actively into the post devolution arenas of policy making in Wales and start following those involved in mapping rural statistics. While conducting the fieldwork, it was important to always keep the focus of discussion close to the themes relating to rural statistics and their subsequent representation: the underpinning of this thesis.

5.5.6 Accessing the Network

Fieldwork began in 2010 and was completed substantially by the end of 2013. The context for the inquiry is described in more detail in Chapter 4. The fieldwork was set

into two major stages with an interlude within which reflection on the first stage of work was conducted in order to guide the later stage of research. This resulted in the research design also containing a longitudinal component. At the time of writing (2013), a minor element of data collection continued but it was felt that this was simply adding to the bulk of knowledge that already been collected and not necessarily revealing anything that had not already considered with regard to the representation of rural statistics. This was point where theoretical saturation had been achieved.

All fieldwork was conducted in Wales and this meant that research was undertaken within a commutable distance of my residence and office in the urban settlements of Cardiff. This meant that the logistics of field visits were not difficult to arrange and could be undertaken at short notice. There were a couple of occasions where interviews needed to be conducted via the telephone; however, these were in the minority.

Infiltration within a network of actors had to begin somewhere. To access information likely to illuminate answers to the questions of this thesis, it was important to engage with those actors most likely to be involved in daily activities that required the collection or dissemination of area-based statistics. The DU, Wales, was identified as a key organisation (see Chapter 4). This organisation was deemed likely to contain actors who could facilitate access to others linked within this field. The DU had a pivotal role in terms of data dissemination between the WG and local government, amongst other duties.

During the initial stages of field research, a meeting was arranged with two key members of the organisation: the Executive Director and the Head of Data Development and Support. Both were able to provide an overview of mapping-related activity in Wales from a strategic perspective. Moreover, the meeting provided a means of gaining access to others within this organisation and opened the door to the organisation's existing range of established working networks. The meeting proved a useful means of bridging between theory and practice.

This initial meeting helped crystallize some early conceptual ideas developed from the literature. It also expanded the scope of the study, by drawing on the experiences of those working at DU. They suggested additional topics worthy of consideration, which presented possible further lines of enquiry relevant for this thesis. The meeting, therefore, served as a two-way information exchange process. The members of the DU were provided with an overview of the initial research plan, aims and objectives. The interviewees provided a descriptive account of what they considered to be the current state of play in relation to mapping and statistics in Wales and the pathway along which the organisation was headed - most notably through their plans for InfoBase systems. InfoBase acted as a Web-based portal for social and economic statistics in Wales and contained a dynamic choropleth map.

Following the initial meeting with the DU, a series of in-depth interviews were planned. This was to provide the research subjects with a direct opportunity to convey their own perspectives on the InfoBase systems as well as to talk more generally about their use of mapping in the policy making process. The interview schedule was designed around several key topics emerging from the literature. The interviews were designed so that any additional issues could be explored in more detail if they emerged. As such, interviews were designed to uncover the meanings and interpretations of the participants through the explanations they provided, whether spontaneous or in result of interviewer stimulus. The results of this stage are included as part of the analysis section.

5.5.7 An Overview of the Research Design

Although the study was conducted in a continuous and iterative manner, for the purpose of description it can be divided into several phases with each phase involving a series of interviews with those linked to statistical analysis and mapping activities for policy making. These phases have been shown within Table 5.1.

The first stages of the research design involved entering the network and introducing my role within the network as a participant observer. The first interview functioned as a pilot in which lines of questioning could be tested and the interview schedule refined.

In phase one, a series of exploratory and group interviews was conducted so as to provide an overview of the roles of participants and their interactions in the policy making network. Interviews and observation aimed to uncover common practices; their position on mapping rural statistics and any other issues and barriers.

While conducting the interviews, care was taken to ensure that they were not overly structured. Sometimes this meant that interviews did not proceed rigidly to the interview schedule. This was not an issue and was expected and planned for by purposefully building a degree of flexibility within the interview schedule. This flexibility enabled discussion to move beyond focussed and sequential questioning. The result was that the schedule could incorporate unforeseen elements that may not have been revealed or been sufficiently addressed using closed questioning techniques or a questionnaire.

Table 5.1: Stages Within the Research Design

| Stage | Organization | Reference |
|-----------------------|-------------------------------------|-------------------|
| Access | Data Unit | D1, D2 |
| & Piloting Interviews | | |
| | | |
| Phase 1 | Data Unit | D1, D3 |
| Phase 1 | Powys | P1, P2 |
| Phase 1 | Conwy | Co1 |
| Phase 1 | Caerphilly | Caer1 |
| Phase 1 | Vale of Glamorgan | V1 |
| Phase 1 | Bridgend | B1, B2 |
| Phase 1 | Carmarthenshire | Car1, Car2, Car3, |
| | | Car4, Car5 |
| Phase 1 | Isle of Anglesey | A1 |
| Phase 1 | Gwynedd | G1, G2 |
| Phase 1 | Monmouthshire | M1, M2, M3 |
| Phase 1 | Welsh Government (Statistics) | WG1 |
| Phase 1 | Welsh Government (Cartographics) | WG2 |
| Phase 2 | Carmarthenshire | Car2 |
| Phase 2 | Carmarthenshire | Car 3 |
| Phase 2 | Carmarthenshire | Car 4 |
| Phase 2 | Business in Focus - Carmarthenshire | B1, Car5 |
| Phase 2 | SWRL | S1, S2, Car5 |
| Phase 3 | Data Unit | D4, D5 |

Phase one, then, essentially sampled elements of the network based around a common problem – the representation of social and economic statistics. In total, first stage discussions and interviews have taken place with five members of the DU; nineteen members from nine LAs and two members of the WG.

From the data gained in this phase of the study, a preliminary thematic analysis was conducted. Lessons, in terms of the efficacy of various parts of the interview schedule, were learned and avenues opened in terms of developing the next stages of research. Reflection, on this first stage of the research, enabled a more targeted second phase of field research in which a particular case was explored in more detail based upon the collective mapping activities in one particular part of Wales: Carmarthenshire.

A revised interview guide was produced for the second phase of research, based on initial findings from the first phase. In phase two, case-based interviews were conducted with each interview centred on a single use of mapping in relation to social and economic statistics. Subsequently widening to actors that were enrolled in this process. This meant that the interview schedule was designed to elicit the experiences and thoughts of interviewees who were asked to talk through the stages of developing a map. The pathways of the resulting maps were then tracked.

Phase three of the study brought the research back to the DU where the field study began. A further interview was conducted based on reflection of phases one and two. It aimed to investigate what had changed at that organisation and in terms of the wider developments within the network. This essentially added a quasi-longitudinal element to the research.

Analysis of the interviews, observations and material generated from all three phases will be discussed in Chapter 6. The results enable the generation of a theoretical framework that could be used in further studies. The following section describes each of the phases of research in more detail.

5.6 Following the Actors - Gathering Evidence in the Workplace

The following section describes each of the phases of the field research as they occurred in order to outline actions that can be replicated or developed in future studies of this type.

5.6.1 A Beginning - the Data Unit

Practicing the interview schedule informally with work colleagues and friends ensured interviewing techniques could be practiced and helped highlight any obvious design issues. This provided solid grounding to begin the first phase of data gathering.

Early in 2010, the interview schedule was piloted in the field with two members of the DU, providing an opportunity to test the length and timing and content of the interview. As many of the themes had already been covered in the initial meeting, it was useful during these interviews to tease out more detail and gain the perspectives of those staff directly involved in the running of the InfoBase project and the management of social and economic statistics. Feedback from these interviews enabled some of the questions to be further fine-tuned at the start of the project (e.g. some of the terminology) but more subtle signs that change was needed came through assessing the content and quality of the responses provided.

Both interviews took place at the DU Offices based in Cardiff; conducting the interview at this location helped clarify and develop an understanding of the structure and the functioning of the DU as an organisation; the type of working environment in which the day-to-day activities of interviewees took place. The interview, however, was conducted in a quiet meeting room with two key personnel: the Executive Director of the DU, Wales and the Project Manager responsible for the InfoBase project. The interview was recorded with the permission of the interviewees, using a small handheld Dictaphone that was placed discreetly on the table. Each formal interview was recorded for post-interview transcription and analysis. Field notes were also taken whilst at the location to log any useful observations. These procedures were followed for all interviews and care was taken to always establish a priori rapport with the interviewee in order to make them feel comfortable enough to provide truthful and honest responses to questions.

5.6.2 Local Authority Interviews - 2010/2011

Research participants were contacted who acted as spokespersons for the following LAs: Isle of Anglesey, Gwynedd, Conwy, Powys, Carmarthenshire, Monmouthshire, Bridgend, Caerphilly, and the Vale of Glamorgan.

LA interviews began with a visit to Powys County Council. As Powys spans almost the majority of rural Wales, it was not surprising to find that the council had several offices at Llandrindod Wells, Brecon, and Welshpool. The interview was conducted at their Statistical Research and Information Unit in the County Hall at Llandrindod Wells. The interview took place with the statistical research and information manager (P1) and an Assistant Research Officer (P2). The interview involved a tour of the department and a presentation of documents containing maps produced by the interviewees and a live display of novel types of mapping activity and their statistical portal called Powys-i. Several documents were provided for post interview reflection and interpretation.

As explained earlier, each additional LA interview was conducted following replication logic as detailed by Yin (2004). Another interview was conducted with a Research Officer from Caerphilly Council (Caer1). This required travelling to the council's new offices in Penallta House at Tredomen Park, Ystrad Mynach. Upon walking into the building, it was hard to miss a large map setting out the LA developing plan dominating the reception area. The interview took place in a private meeting room with glass walls elsewhere in the building. While being led into the building, several colleagues were introduced; however, the interview was conducted one to one in a glass walled meeting room - unlike the previous interviews.

Unfortunately, due to resource (mostly time) constraints, it was not always possible to visit each interviewee in person. There were only three situations where this occurred and on these occasions the interview had to take place over the telephone. The interviewee was asked in advance if they would be happy to be recorded and informed when they would be recorded during the interview and the resultant material transcribed at a later date.

To record the first interview, with a Principal Research and Information Officer at Conwy Council, a private room was set up with a telephone. The telephone was connected so that the audio also passed through a Dictaphone for the interview to be recorded. An electronic copy of the visual stimuli material was sent to the interviewee by e-mail at the start of the interview and the interviewee was asked to have the information in front of them as the interview proceeded. When the time came to discuss this material, the interviewee was instructed to open each page when instructed and each item was discussed. Sturges and Hanrahan (2004) found little

difference in moving from face-to-face interviews and the telephone. They found telephone interviews to be equally robust with respect to breadth and depth. Several other studies have found telephone interviews to be a worthy alternative (see, for example, Block and Erskine (2012)). Although not being able to offer the full gamut of social cues (such as body language), and observations and experiences of being in the working environment, the telephone interviews had certain advantages over face-to-face interviews in several respects and therefore deemed a worthy tradeoff.

Firstly, two of the most obvious benefits are cost effectiveness and time efficiency. The telephone interview offered an extended geographical range at an instant without the cost associated with travel (financial, time, petrol, pollution, and adding to existing congestion). It enabled interviews to be scheduled at convenient times during a working day with less *a priori* commitment. Secondly, it offered the interviewee an element of privacy as other members within the office would not be as aware that an interview was taking place or who it was with, allowing the interviewee to freely discuss sensitive subjects if required. Thirdly, many of the interviewer's effects were removed and the interview schedule could be more easily referred to without visually distracting the interviewee and disrupting responses. This enabled better sequencing during the interview and permitted more improved follow-up questions as better notes could be taken through not having to keep eye contact.

The second telephone interview was conducted with a Principal Planning Officer (A1) with multiple roles (including research and GIS) working at the Isle of Anglesey Council. The interview proceeded using the same methods and techniques as the first. The only other telephone interview was conducted with two officers at Gwynedd Council (Senior Research and Information Officer (G1) and research officer (G2)). Again the methods, above, were replicated but a conference call was set up in the office at Gwynedd Council. This enabled both interviewees to listen to the research questions simultaneously and offer opinions like in a group discussion. Although useful, the interview highlighted a limitation in the telephone method. Although not encountered during the research, it was noted that any additional participants at the other end of a conference call interview would potentially make it difficult to distinguish between each interviewee's responses. As both interviewees' working at Gwynedd Council had a distinct voice, there was no need, during the interview, to ask them to state their name each time they responded. This enabled the discussion to flow more naturally.

Despite conducting interviews by telephone offering several advantages, the preference during fieldwork was to conduct the interview face-to-face. The next interview was conducted at the Vale of Glamorgan Civic Offices in Barry with a Senior Research Officer (V1). This interview was conducted in a public place within the building at the interviewees' request, as there were no available meeting rooms. A relatively quiet table was found, although the resulting audio contained background noise and resulted in transcription being more difficult and time-consuming. An additional benefit of being at the location was the ability to speak to colleagues when being shown around the building. From this, it became possible to speak to a second interviewee who was a GIS officer. An impromptu demonstration was provided of the in-house GIS system and the technical and organisational aspects of its upkeep were discussed. It was noted that there appeared to be little expertise in terms of in-house mapping of social and economic statistics, although the first interviewee did indicate another person normally did this but was on maternity leave.

Next, an interview at the Groundwork building in Tondu, Bridgend, was set in place with a Rural Development Manager (B1) and a Policy and Performance Management Officer (research) (B2). The interview was conducted in the office of the rural policy officer and the other interviewee travelled from their office to the same location for the interview by train. The interview was interesting as apart from responding to each questions posed, the interviewees - at points - began bouncing ideas between each other which provided an additional dynamic. In addition, the interviewees presented examples of Web-mapping projects and policy and research reports (e.g. WRO report which contained multiple thematic maps).

A group interview was arranged with several people linked to Carmarthenshire County Council. The initial contact had kindly arranged to gather a group of people together who had worked using GIS to perform some form of mapping. The interview took place in a large meeting room that had been set up for a live demonstration of the mapping software available at the authority. We all sat around a semi-circular table and the Dictaphone was placed in the middle. Before beginning, a brief description of my research was provided and the format of the ensuing discussion was clarified. At the beginning of the interview, each person's name and role was provided and this was noted along with the position around the table. Although providing useful information, the interview was somewhat skewed towards the opinions of one individual who facilitated and elaborated on the responses of others. This was useful because of the wealth of detailed knowledge and experiences

brought to the discussion but resulted in some interviewees not having much of a voice during the interview. After the interview, while being shown out of the building, it became clear that several interviewees felt they had more to offer to the research. This was noted and revealed a weakness in the group interview. This was interesting as it indicated that there were perhaps different mapping experiences within this same LA and each had a story to tell. The LA participants were penciled in to the diary as a potential candidate for a more in-depth study as part of phase two of the research.

A final interview from phase one took place, with several policy and GIS officers working at Monmouthshire Council. The interview was conducted at Innovation House at the Business Park in Magor, Monmouthshire, and organised by the Head of Collections, Standards and Training (M1). Again, a private meeting room had been set up and two research and policy officers sat around a circular table next to both full-time and part-time GIS technicians. An interesting discussion ensued but at this point it became clear that further interviews were unlikely to offer much more insight to the research questions of this thesis. Themes and topics were starting to become familiar and at this point it was decided that a new line of questioning would be required to move deeper into the practices of those working with rural statistics.

5.6.3 Interviews at the Welsh Government

Interviews also took place within the WG and were conducted with key individuals with regard to the subject matter of this thesis. A national perspective on the representation of rural statistics for policy making in Wales was sought. This proved to be a useful contrast to the experiences found at LAs. Representing rural statistics nationally entailed different and sometimes contradicting requirements to that of local government.

Key informants were targeted strategically because of their roles and because of previous experiences of their ability to speak on behalf of the organisation about topics related to this thesis. These actors represented spokespersons in relation to resources available to the WG for mapping rural statistics.

Interviews followed the same general script structure used with the DU and with LA personnel but the wording and style of some interview questions had to be adapted. The overall effect was minimal but took account of the different overarching role of

the WG, in terms of coordination and policy making. The general themes remained unchanged.

Interviews took place within the Cathays Park office. The location consists of two buildings; the older building contains offices for the First Minister for Wales and senior civil servants, whilst the newer building is a large modern building built as an extension to the older building. The interviews took place in the newer building. Interviews took place with a member of Geography and Technology Knowledge & Analytical Services and with a rural statistician. Although the majority of the building contained an open plan office design, with desktop workspaces for employees, it was noted that the Geography and Technology Knowledge & Analytical Service had their own room in a different part of the building. An interview took place in this office whereas the other interview took place in an open plan office.

At this point, interviews had been conducted at LAs and the WG. A purposeful break was imposed in the fieldwork in order for the previous interviews to be transcribed and thematically analysed (see Section 5.7) in order for a more focussed second phase of research. Next, a new interview script for Phase two was designed that revolved around the issues found in practice as well as in the related literatures.

5.6.4 A Localised Study of Mapping Practices- 2012/2013

Phase two of research was designed so that it would be possible to study more closely some of the practical issues and differences that unfold when mapping rural statistics. Instead of talking broadly about mapping and rural statistics, this phase was about looking at the details. The aim was to pick one LA and follow those involved in mapping processes. The aim of this stage was to uncover how maps become used as part of decision-making processes.

During the first phase of research, each interviewee was asked if it would be possible to speak to them again at a later date. As a list of contact details had already been created at the start of fieldwork, making re-contact was relatively straightforward.

Powys was initially selected as a candidate because the earlier interview revealed that there were established mapping practices at that LA and that almost all forms of social and economic mapping covered the dimension of rural statistics. In addition, maps were being used to function for multiple purposes, sometimes even for

directing funding to that LA. A letter was composed, detailing the intentions of the second phase of research. The letter again requested permission to come to speak to staff at the LA but highlighted the need to observe mapping processes as they happened and follow the path of the map through the network. Unfortunately, there was no response to the request. At this time, however, the Census 2011 had been undertaken and as a result the authority may have been busy preparing for the release. Nevertheless, the request was followed-up with a reminder e-mail. This provoked a response from the contact at the LA. However, that might have been expected, given the increasing burdens being place on LAs at that time due to austerity measures. The contact apologised and informed that due to time and resource pressures there was no scope to be able to take any further part in the research.

As Powys was not able to participate, another predominantly rural LA was selected. Carmarthenshire had already been noted as a potential candidate. A network of participants already involved in mapping had previously been assembled, some of which had indicated that mapping practices were not as unified as presented in the group interview. This, alongside several other interesting factors and issues uncovered during the initial interview itself, made Carmarthenshire an interesting case for follow-up research. In addition, the LA jurisdiction contained both rural and urban settlement structures but was classified by the WG as a rural authority. Therefore, this one LA contained many of the major elements being studied within this thesis and in some ways reflected, at a local level, the issues of mapping Wales as a whole. In addition, it was relatively accessible in a day by car and therefore overnight accommodation was not necessary. Again, a request was sent to the contact, who acted as a gatekeeper to other contacts in that LA.

Unfortunately, it was discovered that one of the original interviewees (Car2) had died during the intervening period, and apologies were given to the contact. This sad news meant that some of the roles of staff had changed within the LA to compensate. What it also meant is that a wealth of knowledge and expertise in mapping rural statistics were no longer available. This vulnerability in the succession of mapping knowledge within organisations also highlighted some of the limitations of longitudinal-based research.

Carmarthenshire

What this meant for the study was that an original interview had to take on some of the mapping duties and related tasks, for example, helping to produce a single integrated plan. A second interview was arranged (with Car1) and functioned to catch up on developments since the initial interview (over a year later); study mapping in practice and follow the immediate network of contacts with an interest in the types of maps produced. During the interview, the participant was asked to perform a mapping activity using social and economic statistics while talking out loud in terms of their thoughts whilst producing the LA map. Questions were also asked during the process to encourage the interviewee to elaborate on actions. A map was produced showing benefit claimants. At the end of the interview, a list of known contacts was requested who had an interest in these types of maps. In addition, an example of where a similar map had been used in an internal report was provided. The interviewee shared a room with the GIS technician who provided some of the GI for these types of mapping processes. An interview was also requested with this person, and followed the same line of questioning. Coincidently, the mapping server was not working during this interview so no live demonstration could be provided.

Another interview was also arranged with one of the original interviewees (Car3) and this took place at another site of Council offices. The interview proceeded using the same structure as the previous, although the type of mapping was much more explorative and interactive, that meant an alternative style of questioning was required during the live demonstration of the mapping process. The demonstration showed how flying start allocations were made within the jurisdiction of the LA. Again, a list of interested parties was requested, but the trial led back to the WG.

New interviews were arranged with some other networks linked to the LA which had an interest in these types of maps produced. A second interview was arranged with the manager of the Beacon Centre of Enterprise, Llanelli. This interview was designed to provide some institutional context and uncover the role maps played at the organisation. Several colleagues were introduced, including one of the original interviewees (Car4). The discussions involved a reflection on the types of social and economic maps produced at the LA. Following the trial further, another interview was arranged with a newly formed Regional Learning Partnership South West Wales (RLPSWW).

In February 2010, the DU was commissioned by the RLPSWW to develop a pilot observatory focusing on the Amman and Gwendraeth Valleys. The pilot was delivered in June 2010 and was well received. The pilot subsequently formed the basis for the wider regional roll-out and development of the observatory. Regional Learning and Skills Observatory (RLSO) was derived from data held within the national InfoBaseCymru product; with relevant additional data sourced from local partners within the south west Wales region.

An interview took place with the project manager and several officers linked to the project (including Car4). Again, the context to the project was discussed and the role that maps play was explored. The mapping process here linked back to the DU, and the map-derived intelligence linked out to a wider network of partners.

Bridgend

A follow up meeting was also requested with original interviewees in Bridgend. This aimed to provide an element of contrast to a predominantly rural authority. However, it was found, when attempting to re-contact original interviewees, that both had moved onto different jobs and roles. This was somewhat problematic and highlighted again difficulty in conducting in-depth longitudinal research at an organisation. The original contact was helpful and passed details of their replacement. An interview was organised. The interview aimed to function similarly to those in Carmarthenshire. However, it became apparent that the new participant was less enthusiastic about mapping. Also present at the interview was a representative of the Local Service Board who was also provided their opinion on mapping developments at Bridgend. The interview revealed that there was a change in focus at the LA towards working towards the priorities and boundaries of the LSB. New Neighbourhood Network areas had been created based on existing based on existing health and policing working arrangements. The mapping activities ultimately linked back to the DU who at the time had developed a local InfoBase System for Bridgend and helped create the neighborhood network boundaries. The Bridgend InfoBase system is no longer available; instead the LSB simply provides links to InfoBase Cymru (the free public version) and also to other websites that house social and economic data.

5.6.5 Returning to the Data Unit 2013

A final interview took place with the DU as the majority of interviews led back to this location. The interview took place with the InfoBase manager (D4) and another

officer (D5) who had worked on the more technical aspects of the systems. The interview served to reflect on the intervening period and the main issues discovered during the previous interviews. In addition, as the new Census 2011 data had been released, the affect it had on the DU in terms of mapping was discussed. Ultimately then the research had come full circle and ended back where it began.

5.7 Making Sense from the Evidence

This section details how interview data was deconstructed to meet with the requirements of this research project. The scoping phases of the research were based on the grounded theory method. The research functioned to discover what was going on from the perspective of the participants. Although the literature had been researched, it was fragmented and had not been brought together as a whole for this type of study. So, rather than test a hypothesis, the analysis had to make sense of the data provided and collected.

The main technique for interpreting the data gathered during the first phase of the research was thematic analysis. Thematic analysis in its simplest form is a systematic strategy for categorizing qualitative data. Data is reviewed followed by an iterative process of note taking, categorizing and further review. According to Lapadat (2010), it typically involves recognizing cultural meaning through codes and patterns; by coding and classifying mostly textual data according to themes; interpreting resulting thematic structures by seeking commonalities, relationships, overarching structures, theoretical constructs, or explanatory principles.

Thematic analysis has been referred to as a "foundational method" for qualitative analysis (Braun and Clarke 2006) with reference to its applicability to most scenarios. As part of this research, it is not really considered a research method but rather an analytical approach and a synthesizing strategy, used as part of a meaning making process. Similarly, Ryan and Bernard Creswell (2002, p. 485) locate thematic coding as a process performed *within* 'major' analytic traditions, rather than a specific approach in its own right. Thematic analysis, in its broad sense then, can be used with many goals in mind. As such, it can be used in many types of qualitative analysis, such as case study, grounded theory, as well as discourse analysis. Therefore, it seems that thematic analysis is not wed to a single pre-existing

philosophical framework. This makes the approach flexible but does not mean that anything goes and its use in context needs to be made explicit.

Thematic analysis can be used as part of realist method, which reports experiences, meanings and the reality of participants, or it can be a constructionist method, which examines the ways in which events, realities, meanings, experiences, and so on, are the effects of a range of discourses operating within society. It can also sit somewhere between the two poles characterised by theories, such as critical realism, which acknowledges the way individuals make meaning of their experience, and in turn, the ways the broader social context impinges on those meanings, while retaining focus on the material and other limits of 'reality'. Therefore, thematic analysis can be used both to reflect reality, and to unpick or unravel the surface of 'reality' (Ryan and Bernard 2000).

Thematic analysis was applied during this thesis in order to make sense of what was told from the perspectives of research participants. Although themes from the literature had a role to play in determining initial broad categories, these codes served simply as a starting point and the codes that eventually emerged were inductive and derived from a bottom up reading of the data. Using this approach enabled the research data to be carefully unpacked, enabling patterns and themes to develop. Thematic analysis in this research, therefore, contains elements of phenomenology and of grounded theory without fundamentally adhering to these in full methodological regalia.

The purpose of using thematic analysis to interrogate the data was to get closer to the data that was collected to develop a deeper appreciation of the content. Themes produced through this analysis could also be pursued in latter stages of the research where more fine-grained analysis could be conducted around these informed topics.

Interviews were compared between different types of organisations; different roles and according to the size of the LA. Each interview was reflected upon according to the themes in the literature.

A range of artifacts was provided and reflected upon during the interviews. These were also available for post-interview analysis. In addition, several policy documents and reports were explored and analysed in terms of their content and the themes emerging from the interviews. In addition, it was possible to critically compare and

contrast how social and economic maps were being used to present rural statistics. As the research also contained a longitudinal component, it was possible to witness the changing styles of representation (for example, see Appendix J for different maps produced for Bridgend Council). Much of this material has been unpacked as part of the analysis (in Chapter 6) based on context already provided (Chapter 4).

Chapter Summary

This chapter has been concerned with detailing the methodology that frames this thesis. It adopts a predominantly qualitative approach within a case study design to uncover the conditions for mapping in rural statistics in Wales. It is in this sense this research has utilised the concept of grounded theory to pull layer together evidence to help understand theoretically the relationships between people, maps, technology, organisations and decision making. The research was designed based on an interpretive perspective so that qualitative perspectives could be used to understand and follow aspects of quantitative practices. Evidence was gathered from the perspective of key actors working in organisations that had a role related to the subject matters of this thesis. Interviews provided the main source of evidence, as well as artifacts and observation. These were interpreted based from the perspectives of participants and discussed reflexively based on the researchers experiences. The aim was to uncover issues that could affect the representation of rural issues within mapping practices.

Interviews were conducted broadly to begin with and when it was felt that topic saturation had been achieved, the research moved in to a second stage. The results of the second stage provided a detailed profile of mapping practices in one LA. A third angle was also achieved as there was a quasi-longitudinal component to the research. It was conducted over a period of years. To investigate ongoing changes to mapping practices in Wales a final meeting took place where the research began, at the DU. The next chapter provides the analysis and results of this research as it met its objectives and responded to the research questions set out at the beginning of this thesis. A narrative has been constructed broadly around these questions. Emerging issues were prioritized, however, rather that adhering to strict categories. As a consequence all of the subsequent sections contain elements that respond to the research questions in one way or another and these well be reflected upon throughout. The main findings will however be brought together in the final chapter.

Chapter 6 - Analysis of Rural Mapping Practices in Wales

Introduction

The purpose of this chapter is to explore how key individuals working in policy-making organisations represent rural statistics for Wales. In doing so, this chapter explores map-mediated interactions as part of socio-technical processes. It aims to examine mapping situated in a specific time and place; the knowledge produced and the outcomes of these processes of examining maps.

This analysis presents not only a description but also a critique of current practice. A critique does not consist of just saying things aren't good the way they are. A critique consists of assessing what type of assumptions; familiar notions; established, unexamined ways of thinking upon which accepted practices are based (Foucault, 2000, p. 456). Without questioning map-mediated decisions within governance in Wales, there is the potential for inappropriate practices to persist. A potential result of these enduring practices could be that certain people and issues remain hidden from the policy making process.

6.1 Sensitizing Concepts for Analysis and Interpretation

Exploring and presenting the human perspectives on sociotechnical processes was a complex task. To understand the complexity of the components associated with mapping processes in a decision-making context, a strategy was required. A common strategy is simplification.⁴⁴. Simplification is required in order to be able to represent the infinite possibilities of complex situations (Latour, 1987); however, it became clear that relying on this alone ran the risk of removing things that constitute the description needed, by concealing the activities and parts played by people and their devices. Law (1999) emphasizes that these complexities are not lost. In terms of this analysis then, the problem was how to effectively capture complexity but keep within the bounds of the study. It was clear that there was a need to keep this complexity manageable for interpreting interviews, observations and artifacts within this ethnographic research.

⁴⁴ In fact, this was done when performing a quick initial thematic analysis of the interviews as part of Phase one of the project in preparation for Phase two.

6.1.1 Actors, Networks and Artifacts

The simplification concept was used to suggest key moments in which people and technology became intertwined. These have been termed obligatory points of passage (following Callon, Latour *et al.*). These then are the critical channels for map-mediated interaction. They ensure certain modes of communication must pass through these domains; hence, ensuring nodal points and indispensable places within the network.

Within this, key actors have the agency to manipulate the rules and resources at their disposal and then can, in turn, shape how others interact. However, to an extent the rules and resources also limit the agency of key actors. Rules and resources may be influencing local decisions but from a distance (e.g. decisions made by the OS or UK policies related to data). The simple point being that both can influence the network. Rules and resources brought together within the network are more likely to become learned knowledge, whereas those outside the network of associations are not. These are important points as they help explain how the field of cartography and scientific visualization become incorporated in policymaking practices and processes and what can count as policy fact and acted upon. To provide the context for the 'analysis chapter', Table 6.1 sets out several specific intersections within these networks, around which detail will be elaborated.

Table 6.1: Sensitizing Devices for Focussing Analysis

| Focus for study | Example |
|--------------------------|--|
| Organizations | Collectives that have roles. Shaped by rules and resources and |
| | contain key actors with agency, e.g. WG, DU, LA |
| Key actors | Research participants, offering a lens on private mapping |
| | practices within organizations |
| Geospatial technologies | Desktop GIS, InfoBase, Distributed GIS, Web maps, GPS |
| Geographical Information | Spatial (e.g. grid reference) and social/economic data (e.g. |
| | census or survey data) modeled in relation to the world. |
| Networks | Digital (e.g. Internet or WWW, mobile) and human (e.g. policy, |
| | partnerships, working groups, associates, meetings) |
| Medium or vessel | Human-Digital Interface (e.g. screen, Physical artifact (e.g. |
| | Paper Report), People? |
| Mapping | Geographic representation, thematic map, cartogram |
| Policies/legislation | Programme for government, Data Protection Act, RDP |

Latour (1987) suggests that it is up to the researcher's judgment to determine who the important actors are that should be followed. As part of this research, these were chosen by considering who were influential in establishing rules and resources for use within policy-making networks. Attention could then be directed towards how those associated with this network responded to this influence and how practices were changed as a consequence. This enables the research to expand to explore periphery organisations in the future. The ultimate goal was to consider how all these elements affected the representation of rural statistics by interpreting and reflecting on the experiences of the interviewees.

Despite these elements of simplification imposed to ensure the analysis was manageable, a focus on interpretation from the perspective of participants ensured that any elements of complexity were not lost. The details of how they responded to issues and defined themselves within these contexts were what were considered important.

6.1.2 Benefits of the Application of this Framework

This framework can be used to study local and global networks and can help to understand mapping practices on several scales. To use an initial example, take the OS: it has a clear role as a focal actor in mapping networks in the UK. Through its inscriptions (producing a detailed topographic map of the UK), it has ensured that is an obligatory passage point for key actors and collectives that have a stake in spatial data. The OS has come to be accepted as an official source of spatial data and has come to set the rules and standards against which other actors' actions are judged and, as such, it has become a voice for mapping practices in the UK. As maps are enrolled in policy making, the interests of these collectives are aligned.

However, in assuming the role elements of the activities of the OS become 'black-boxed' (for example, the underling geodesy and use of Cartesian space; the choices of what to include in the map; the choice of referencing system). The work of the OS then affects other mapping practices. Many may be unaware of the choices already made, especially the detail, and how they are often inadvertently affected by these choices. Also, they may well be aware of issues but are not able to challenge the orthodoxy of the focal actor. Therefore, there is an element of irreversibility in this alignment within the actor-network as, despite challenges from Google and the like, the 'map metaphor', set to standards long before, remains.

This familiarity with the 'map metaphor' or the way maps should be, means that mapping prioritises landmass over people in most resultant technical artifacts⁴⁵. Maps are produced in which interests have become aligned, and remain aligned. This creates mapping practices that are often without the representation of people in mind (Miller 2007).

In fact this is what this thesis aims to explore; the resulting alignment that may be in the interests of some but not all people and organizations. The focus here however is the alignment between the WG, local planning authorities and their data custodians. This is where mapping practices for social and economic statistics happen within local networks. This is where potential difficulties can be found for those attempting to represent the characteristics of sparse populations.

In Wales, specifically mapping practices have developed for representing social and economic statistics. As such, many obligatory points of passage have been created for knowing about rural Wales. Some can be found within the local network (e.g. trained staff) while others are from the influences of wider (or global) networks. As such, the OS; Geospatial software and technology companies; the ONS and Westminster; the EU and international directives; polices and laws all can act within local networks but from a distance.

The following analysis will focus, but not be limited to, the local network in Wales as outlined in Table 6.1. It will expand on several nodes ranging from the role of the WG; the role of the DU and its InfoBase product; collective local mapping practices and how key actors go about their business of mapping and using maps. The interplay between the WG, LAs and the DU provides the backbone of mapping and policymaking in Wales as each can act as an obligatory point of passage for both. In the future this could be contrasted with other sector specific work programmes (e.g. Public Health Wales; Sport Wales) and the work of partnerships, however this was beyond the capacity of the current study.

For now, a narrative will be created based on key themes and interpretations emerging within the literature, and the stories, observations, and artifacts of mapping practices uncovered when following the research participants. When convenient, the discussion will broaden to consider the wider networks that can influence local

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⁴⁵ In fact, it seems that the original GIS systems were designed to map trees and not people.

mapping activity. Reflecting on the current issues perceived by those involved in policy-related mapping practices in Wales would help to reveal some of the juxtaposition of needs, and interests. This section will be interlaced with the issues found in the Chorley Report, almost thirty years ago, and has the aim to expose enduring barriers remaining in Wales. How is the alignment of map-based associations currently reconfiguring it and what does this mean for the representation of rural statistics?

This chapter will be split into three major sections. The first (section 6.2) explores existing practices in Wales for representing rural statistics. It therefore aims to reflect on the barriers outlined in the Chorley Report to examine the extent to which these have been tackled and the consequences for the representation of rural statistics. The second section (section 6.3) focuses on a particular LA in detail. It explores, through the experiences of several participants, the often hidden decisions and conditions of mapping practices and map use. The third section (section 6.4) then reflects on the ways in which mapping practices in Wales are set to change and how data custodians and technology are forging a new role within evidence-based policy making.

6.2 Benefits and Barriers - the Limits of Mapping Practices in Wales

This initial section will focus on uncovering existing practices for mapping social and economic data in Wales. It will also then broaden to consider how the barriers outlined in the Chorley Report can affect how rural statistics are represented and the extent to which they have been resolved.

It became clear quite early on in the research that although the academic literature and technology had moved quite deeply into the domain of scientific visualization and geovisualization, the application of this in policy making was minimal. The few examples found were linked to established mapping practices rather than anything more abstract. Explorative mapping was the exception rather than the rule. In addition, the vocabulary used to discuss mapping issues varied with many terms being 'fuzzy' and open to interpretation. This was not confined to technological terms and extended to how places were known. References were made to the difficulty caused by the Anglicisation of Welsh place names and how this could create issues for linking address data. There was a vernacular problem (Waters and Evans 2003)

that needed to be resolved. During interviews when such terms were not clear the issue was pressed in an attempt to achieve clarity.

There was an obvious recognition of the requirement of mapping in policy-making processes in Wales. This was evident from the contextual study, and through discussions with each key actor. The following interviewees stated:

"It's clear that there is a drive towards increasing use of evidence in policy-making overall, and analysis and visualizations are intrinsic to that use of better use of evidence". (WG1)

"We are getting more and more data all the time and more and more government departments we are getting data from, and there is more and more data that is becoming freely accessible...people are expecting...a lot more people understand maps and expect to see maps so the problem there could be is resources...but as more and more open source stuff comes along and as more and more Ordnance Survey mapping becomes freely accessible, that should help". (P1)

Clearly then, as part of the Modernising Government agenda, GI is playing an increasing role. In this sense the issue of data availability mentioned in the Chorley Report can be read from a new perspective. Now perhaps the issue is dealing with the different types of data available - many of which may not necessarily be appropriate. The interviewees above appear to suggest that GI can simplify mapping practice.

Reflecting on the series of interviews conducted as part of this research, in general it appeared that thematic mapping was seen as a useful tool to deal with the increasing availability of GI both at a local level and for Wales in general. The following interviewees heralded the benefits of thematic mapping:

"Extremely useful for a quick snapshot". (A1)

"It is quite intuitive...it is easier as well for users to relate the data to the location that they are looking at, to highlight geographical trends that might be difficult to see in a table". (G1)

"I could not imagine doing without it...not only do we find it useful, but the people we provide the data and the mapping to, find it useful". (P1)

"I feel it is easier for people to get a flavour of statistics from a map rather than from a table because it's obviously a more pictorial way of visualizing the data...it's just so much more a powerful tool than say a chart or a table". (Caer1)

These optimistic viewpoints may be expected given the stake each actor has in these technologies. It was in the interests of these individuals to favour mapping practice as it positioned them within the network as obligatory points of passage for accessing spatial GI. It justified their role. However, what was clearly evident in these statements, and others, was how maps were perceived to function. This was to communicate and raise awareness of information. Currently it is unclear whether mapping is needed because of more data or if new data is being driven mapping practices. Is mapping creating its own problem?

In Wales responsibility often fell upon one or two individuals expected to find the data; manipulate the data; link the data; represent the data; manage the data; document the data; explore the data; synthesise the data; present the data and, perhaps most importantly, understand what has been found, and contextualise this within existing forms of evidence and knowledge. This is without even getting in to the detail and unpacking definitions. With limited staff performing the majority of these tasks, the time available for some processes would inevitably be squeezed.

If the bulk of this time was taken up in during the earlier stages of accumulating the data, it left little time for other stages within the mapping process. It is under these conditions where the representation of statistics could be overlooked or taken for granted. These issues will be discussed in greater detail section 6.2.3. There were also those who were not able to perform mapping themselves and often turned to those with mapping roles to create maps on their behalf. Therefore, there was somewhat of a capacity issue - a problem that the DU has attempted to resolve.

"Well what is useful about being able to do thematic maps online is that it doesn't require... If it's easy enough...it doesn't require...it doesn't cause a bottle neck because there are only two of us we want to be able to plant people to where they can take advantage of the benefits that thematic mapping can bring". (P1)

How the DU has intervened in mapping practices will be discussed later in section 6.4. Firstly, the existing practices will be discussed.

6.2.1 Common Practices, Technical Problems?

The setup of technology varied between organisations but many of the technical processes in producing a map appeared to remain, in general, similar. Perhaps this was because there were only two main providers of mapping technology for mapping social and economic statistics – ESRI and MapInfo. Each interviewee explained a similar collection of GI datasets used for mapping social and economic GI, but the quantity, shape and size of the boundaries available for mapping varied.

Many interviewees stated that when it came to statistical mapping there was a strong link between the data available and the quality of the resulting map. One interviewee noted this explicitly and stated:

"Maps are only as good as the data behind them". (A1)

Each type of social and economic data therefore appeared, to some extent, to mediate the form of representation despite their similar use in practice. The battle for the interviewees was to find the best way to communicate this information for a specific target audience; often this was another member of the organisation or local councillors or funding bodies. This perception of mapping to mediate information without distortion is, however, somewhat naïve as it fails to fully account for the human dimensions of the mapping process (see Chapters 2 and 3) and the fundamental problem of there never being a 'best' map. It is, after all, people who are behind both the data and the maps and it is people who ultimately interpret and put maps to use. Software is developed by people as are the machines and operations required to handle the data created, data that has ultimately also been collected and constructed for a purpose.

Within LAs, it was clear that interviewees had established routine practices and preferences for accessing secondary datasets for mapping. For the few key actors collating the bulk of each organisations social and economic data, the aim - articulated by the interviewees - was to obtain data from sources that offered statistically accurate and detailed information at a local level. Several online data

warehouses were discussed, for example, ONS Neighborhood Statistics, NOMIS, WG Stats Wales. The most quoted data source for mapping was the census but there were also a number of large-scale surveys that offered a range of social and economic statistics.

"It depends on what we are looking at as you know there are information that hasn't been collected since the Census and other information is updated from more recent surveys and sample data so it depends what we are looking at". (Co1)

The LAs and the WG interviews revealed that there was a tendency for those working with quantitative social and economic data to either use tables; basic statistical graphics (e.g. bar charts) or to apply mapping techniques to represent the information. Failing this, the geographic information would be weaved within the text of policy-related documents.

To show basic information, a table was often used; however, if there was a large number of rows or there were multiple variables then simple statistical graphical techniques were used, such as bar charts, pie charts, and line charts (when representing change over time). These were often used to differentiate between groups of people with different social and economic characteristics. When social and economic characteristics needed to be explored spatially then thematic or choropleth maps were sometimes used. These would be used to either display differences between different jurisdictions or to represent point locations (such as the location of a service) or show line features (e.g. major roads). These shape features (points, lines, and areas) were consistently packaged relative to political boundaries using overlay techniques and often labeled with place names. This meant that all features and information could be displayed within a single map view. The following interviewee articulated this common practice:

"We will have to start with excel that everyone has got and we turn those into MapInfo thematic maps where it's a question of analyzing difference between areas...and where it is not a question of that we would not use a thematic map we would use excel bar charts and so on bar charts and line graphs and so on and then we share those..." (P1)

On the surface, this practice appears unproblematic, in fact, relatively straightforward. Probing deeper revealed that there was much more to be understood about these rural mapping practices. Reflection on the responses provided by interviewees helped to expose fundamental problems and hidden alliances. Moreover observing the resulting representations revealed great variation even within these common practices.

Several interviewees suggested that the visual representation of statistics was not without pitfalls:

"The difficulty I have is trying not to get too excited or too carried away with interactive visual tools because what may appealing and useful for me as a sort of a geek in this sort of stuff actually will scare some people off so you need to kind of think with that in mind". (B1)

"There isn't any better tool that we have got really although there are places where it doesn't make sense to use it and we educate people about that if it's the same colour right across the map then you are not using the right tool". (P1)

"Use it but give a health warning because of course what it is...it is only showing high level, you know it is not showing intricacies and it is not showing realities quite often when you look at it at a county level but also when you look at it at a ward level as well". (B1)

These quotes allude to an expert-layperson division. However according to Cidell (2008) this distinction may not be warranted. It is also interesting to listen to how informal learning is being passed on through practical experiences more so than theory. Rather than ontic knowledge developed within the cartography discipline (Dodge et al. 2009), there was a translation to, and within, policymaking practices.

Interviewees suggested how maps commonly functioned within a LA to provide baseline information:

"Any sort of plan or strategy whether its health and social care or if it's sort of the environment; whether its regeneration - a massive proportion of that will be sort of baseline data; the information about what this area is like so like is it rural or urban; what the population is; what the characteristics of those population are...so it doesn't really matter if you like the topic but a lot of the data is used will be that contextual information about the area and the people who live here, so it's using that sort of way really to inform in that format. And obviously you know as I said with the needs analysis to make sure that what we think need to be delivered is actually what is needed in terms of the characteristics of the people living out there". (Caer1)

This suggests maps are being used in a descriptive sense to provide contextual information. Rather than to ask questions and query the GI, the map is presented as a fact. This means that the underlying GI was being used without question. It was assumed to have a sound foundation; a mechanism for communicating evidence. Maps were being used to turn policy claims into policy facts and with that spatial GI had become an 'immutable mobile' (Latour 1986, 1987). However there are both technical (Openshaw and Taylor 1979) and interpretation (Monmonier 1996) problems associated with simply presenting the data as fact within a map.

It is interesting to reflect here on why multiple maps are produced often covering the same data, is it because effort is uncoordinated, is it because it is territorial, or is it simply because mapping is necessarily multi-vocal? Are multiple maps of the same dataset duplication or is it a natural form of exploration?

It was clear that the presentation of a map as fact hid many subjective decisions and assumptions that have knowingly or unknowingly led to the creation of the GI let alone the decisions to organize this GI within the lens of the cartographer. These choices are in fact important, the simple choice of spatial boundary can have unintended consequences and leave certain issues hidden from policy makers. As a result certain people can become marginalised.

When interviewees discussed their practices of mapping social and economic statistics, they mentioned that there was a range of geographic scales at which these data were collected. Often, social and economic data was only made accessible for certain geographic units (such as LA). For some using Desktop GIS software there was also scope to modify the collections of units used so that they could be combined and rearranged to fit particular needs. This was possible because most of the available boundaries had been designed to nest within each other's borders to

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⁴⁶ In the sense that they describe things so that they are made to be easily transportable without changing the inherent characteristics of those things

form a spatial hierarchy. In practice, to construct new territories, those required in rural definitions or planning areas, the predefined suite of existing administrative and statistical units could be exploited. A selection of these common contiguous and coterminous areas (in most cases) could be selected to form a new whole, for example, a rural space.

Now before exploring the barriers that have led to these practices, it is important to incorporate a WG perspective on the matter. This is because it has an important role in shaping the rules and resources in Wales that are within its control.

6.2.2 Defining Rules, Roles and Resources - the Welsh Government

It was interesting to contrast the opinions provided by the WG to that of people working in LAs, as they had to deal with rural issues in different contexts. The WG worked with national data whereas LAs, until recently, tended to be rather inward looking:

"We are probably guilty of that. We tend to only display our local authority area". (B2)

As a result, there were differences in opinion in terms of the issues surrounding visual representation of rural statistics for policy making. These moved beyond technical and pragmatic issues and began to imply underlying political motives or perhaps just an alternative perspective in dealing with maps at national scale. For example, below, a member of the WG described how they did not think the issue was how to represent rural statistics and presented a counter argument:

"...I think we have a problem representing urban data". (WG1)

"This is why I prefer those kind of hexagon⁴⁷ stuff because it takes away from that. It means that everything is getting an equal visual pattern, equal visual impact...I think that's the issue that is the broader issue". (WG1)

"Like the fact that mid Wales, you know, has big swathes of the rural area that's in their interest to pretend that rural issues are the most important one". (WG1)

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⁴⁷ See Appendix F (Showcards) – 4) Cartograms

"The population of Wales and particularly the deprived population of Wales lives in the urban areas". (WG1)

This could potentially lead to a barrier in terms of what is used in policy making because, as WG1 noted, their department:

"Comprises all the people that gather and handling work with the evidence that supports policy generation, service delivery, so all the kind of facts and figures in Wales, all the stuff that goes into assessing how much budget to give people". (WG1)

Clearly, if members of WG1 feel that "I don't think we have a problem representing rural data" then this has the potential to influence the way in which evidence is displayed at a national level to support policy generation and ultimately the distribution of the budget.

As both LAs and the WG appear to have problems representing urban and rural statistics together using maps it suggests that both the scale and the person's perspective create fundamental mapping issues. The issue appears to be that it is difficult to represent both interests within one map. Perhaps displaying the data in multiple ways, side-by-side could resolve some of the technical problems but the political element will still remain – which map is better? The problem is then also political.

Interviewees at the WG appeared to be more cautious in their use of maps and warned:

"People feel very happy looking at maps, they like maps and they think get information from them and maps are superb at giving you the wrong information, they are really good at misleading you". (WG2)

This could be because of their experiences of dealing with an array of local variation at a national level. The interviewee provided a perspective from the position of an expert. Reflecting on the quotes above the WG interviewees appear to consider these expertise also beyond that available at LAs.

The interviewee followed by explaining how they perceived issues to be closely related to the distribution of the population:

"One of the striking features of Wales, as compared to England or Scotland, is just how many people live outside big places - if you want to call a big place something like over 10,000 people. You know there's an awful lot of people in Wales living in smaller towns, villages, even isolated dwellings and so on, so and that's...that can be quite important when you are actually thinking about what you mean by rural. You know what that separate pattern is actually". (WG2)

This quote was interesting in several respects: firstly, it showed how rural issues might not be clustered within predefined units; in aggregate, they may sum to the equivalent of an urban authority. Secondly, it shows that statistical statements can easily be misinterpreted. Common sense would suggest that more people lived outside big places in Scotland; however, when exact statistical boundaries and definitions are imposed, it can be shown that this is not the case. It quite literally is about how you frame the problem or how you spin it (Huff 1954; Monmonier 1996). The MAUP is not just a technical problem in policymaking it is also a political one.

The WG also used grid mapping to attempt to represent the population. The interviewee describes the technical processes behind the creation of this type of map:

"What I'm a huge fan of is...grid-based mapping...we would use a population map on a grid square basis; basically chuck up the population to grid squares and then you would then sort of colour code them up. Now I think they're fantastic..." (WG1)

The raster-based map produced by the WG, shown in Figure 6.1, appears to show that there are large areas of Wales where nobody resides. The interviewee referred to this area as 'empty space'. This may be something of an illusion as people do live and work within these areas but the map summarises the location of households, not the people. Even this summation of households has been generalized within cell-based areas. Therefore, although the map is quite useful for showing the general pattern of household distribution using a land based perspective, if transport routes and accessibility were used to distort the projection of the map (as in population cartograms) perhaps quite a different picture might begin to emerge, even from this basic representation of household locations. Some households depicted in mid-wales may be relatively much further from urban centers in the southeast if travel times

along road networks are considered. Also the elevation of land in some areas could mean that despite households being depicted alongside each another, they may be quite remote from each other and fall within separate valleys, separated by mountain ranges that are difficult to traverse. This information is rarely represented or accounted for in statistical mapping but might be crucial in terms of understanding the information presented for those without local understanding of the settlement structure and geography (e.g. an official within the EU). Maps then may distort how connected rural places are in space.

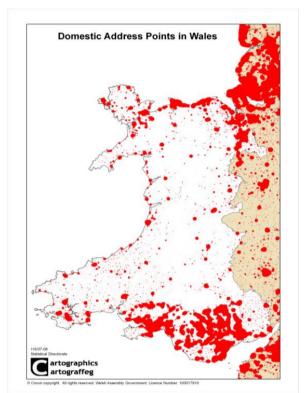


Figure 6.1: Hectare Grid of Domestic Address Points in Wales

(Source: WG, 2008)

Reflecting on this map, the interviewee stated:

"I think that the, particularly in Wales we've got this problem with a big empty middle...so grid-based mapping I like a lot, so it abstracts the phenomena away from any sort of artificial administrative boundaries or anything like that". (WG1)

It is interesting to listen to how rural Wales is described as having 'a big empty middle' but it shows that there was an awareness of the issues linked to rural representation.

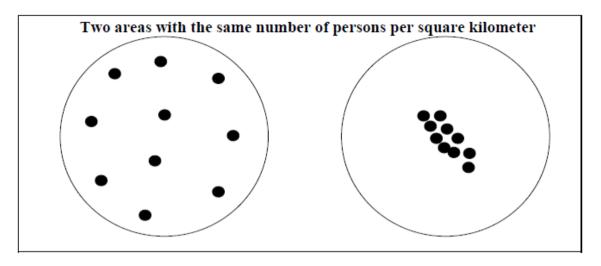
6.2.3 Dealing with Empty Space?

A question posited by one interviewee was: How do we deal with the blank spaces (shown as white within the border of Wales) in terms of mapping the characteristics of the population? Thematic or choropleth mapping was the most common practice adopted both within the WG as well as within local government for representing rural statistics.

This mapping technique involves dividing the land area using constructed spatial boundaries. Many of these boundaries are based on physical characteristics such as rivers, streams, and mountains. Some are delimited according to where streets, roads or railways intersect. This process essentially subdivides geographic space into uneven zones in order to count and gather data about the population. This division of the country into boundaries has a large influence in the resulting picture that can be shown within the map. Regardless of the patchwork of boundaries, the picture can also then vary in terms of its accuracy of the representation to match the underlying settlement structure (see Figure 6.1) in this model. From a technical perspective boundaries are settlement structure when the settlement is uniform in space and also dense within the boundary. This is not common in rural Wales. Therefore, sparse population within a boundary as well as localised clustering within certain areas can affect the boundaries' ability to accurately represent the settlement under investigation. These are technical points and open to interpretation. Perhaps the movement of people within these boundaries make some more appropriate at certain times of day.

Figure 6.2 shows two hypothetical scenarios for comparable boundaries with equal population densities to illustrate these points:

Figure 6.2: Equal Area, Equal Number of Households, Different Distribution



(Source: WG, 2008)

This scenario represents an example of the technical point where the representation of rural statistics could become problematic in comparison with urban areas. This issue replicates itself even within rural areas when more built-up settlements are compared to isolated villages and settlements. There appeared to be an awareness of these issues but presented little effort in offering alternative representational solutions.

The following interviewee articulated the problem:

"With a country like Wales which has got a very patchy population, these choropleths are always going to be a bit of a problem". (WG2)

However more and more of these choropleth maps were being used in an attempt to transfer information without distortion.

6.2.4 Where to Draw the Line? - Issues with Rural Classification

The ecological fallacy and the MAUP have been shown to have a number of consequences in terms of the practice of representing rural statistics for policy making using GIS. However, not one of the interviewees could describe these terms directly without encouragement. They were however aware of some of the practicalities of the problem. This suggests that much mapping practice for policy making is based on pragmatism and trial and error rather than through rigorous theoretical development. Therefore, it is useful to further consider the potential consequences of these issues in terms of representing rural statistics.

An interviewee, from the WG, when talking about classification for mapping, raised some interesting points:

"...[It] can be quite dangerous because how you actually set up and define these categories has an incredible impact on what you see." (WG2)

The interviewee acknowledged that initial modelling decisions had an effect on what was or was not portrayed using a map. The interviewee followed by providing a practical example of the difficulties, noting the subjective decisions made when constructing boundaries to define settlements:

"...use the obvious example from stuff I've previously done, when you're trying to define settlements and so on, you know obviously that one is quite neat, according to the map it has got quite a nice hard boundary, but if you think about the area between Cardiff and Newport, it all kind of blends into one another and exactly how you draw that line then makes quite a big difference, you know if you have a really strict definition Cardiff and Swansea, Cardiff and Newport become one settlement and you've got lots of problems like that..." (WG2)

The interviewee was aware that where lines are drawn they mark a territory and can change how areas were perceived. The interviewee further suggested that skills were required to judge how to do this and there was a balancing act between providing too much information and having too blunt a tool to communicate what the data is intended to show:

"The big worry on something like this is it puts something in one of a small number of categories and there are so many fuzzy edges, it is one where it really does take, it is part skilling and it part art about balancing, you know too many categories and most of them you can't see anyway, so what the hell. Too few and you're losing all the subtle variations and as always it is always more complicated than that and it is not just one thing, it is a bit of this and a bit of that and how do you get rid of the mixes...so it can be extremely good and powerful". (WG2)

The interviewee is aware that having the skill to manipulate the 'fuzziness' in the definition provides a powerful tool but warns:

"But also you can come up with some really funny things coming out of this because of the way you've done your rules doesn't quite work and whatever, and one of the iron rules of all of this is there will always be the cases that are that close to the border and because it's got to go one side or another, where you put it actually matter..." (WG2)

This demonstrated a common problem when quantifying data, be it the units imposed on a population, or the grouping of units, or cut points within a distribution of data. All come down to the choices made by people. The person may have the skill and knowledge to make the decision under the auspices of science or may have a political motive to manipulate the data or may well just guess, as they just do not know any better. This is problematic as funding is often linked to these boundaries.

"One of the things that, I don't know if we get onto them later, but these people who do all these great classifications of typologies of things, where they take loads and loads of variables and just do lots of regression stuff on and to pull out your classes which I heard characterised rather well is taking an arbitrary number of variables and using an arbitrary metric to divide them into an arbitrary number of categories which you give arbitrary names and you call the result insight [laughs] you know... It's not entirely fair but you can recognise what they're talking about..." (WG2)

The interviewee was quite pessimistic of the scientific method and indicates that informed judgment often overrides these methods to make decisions in practice (Figure 6.3):

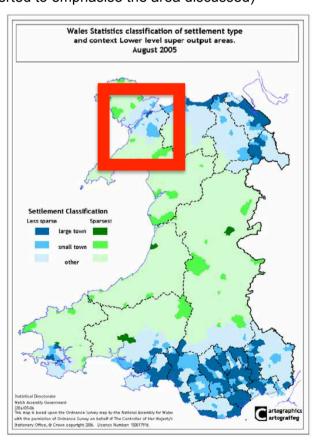
"...there's a very good example of that in the national statistics rural classification, where they have the sparsest context and you've got all your algorithms for calculating this which I won't go into at the moment. But it means that the border between the less sparse and the sparsest goes 3 or 4 miles the north side of the Menai Strait which is a statistical thing, that's fine, that's the line, that's where it is, but if you're actually trying to use that for practical terms, why on earth would you have a 3 mile strip along the Menai Strait that's different from the rest of Anglesey... Erm, yeah okay that's where the algorithm says it goes but for practical purposes, shift it out of the Menai and it's always got those sorts of problems." (WG2)

These are the types of subtle decisions that demonstrate how subjective decisions can easily override any statistical methods used during the maps creation and importantly highlight how political motives could also enter in to the maps design.

Each LA jurisdiction varied and appeared unique in terms of the physical characteristics of the land and its use, the settlement pattern and many other economic, historical, social cultural and political factors. This was noted and emphasized in a number of academic and policy reports. In addition, each LA had a historical legacy of unique boundaries and different applications of rural definition.

Added to these historical definitions was an official classification of rural areas for policy purposes provided by the ONS: a sub LA urban rural classification. When data were not available at a small enough geographical scale, there was a rural-urban LA classification. Population densities calculated from the census underpinned both classifications. In addition, for rural development funding an additional definition had been developed using the ONS classification and other forms of evidence provided by LAs.

Figure 6.3: Urban Rural Classification by the Welsh Government (Note: red box inserted to emphasise the area discussed)



'Rural' Perspectives

The implications of rural classification for those in policy-making networks were found to vary both nationally and locally as well as between and sometimes within an organisation. Some LA officials claimed that their authorities' jurisdiction was entirely rural, whereas others claimed that their authority contained only parts that were considered rural, relative to their urban areas. Accordingly, in practice, some considered any data within their border rural and therefore could represent any information within their border and claim that it was representative of rural statistics (e.g. Powys):

"Well the whole authority is rural without any doubt we are in the sparsest populated county in England and Wales so I mean we have agriculture as the basic industry and there is a little bit of mining". (P1)

Therefore, some LAs could draw upon the WG classification of LAs and substitute LA data as rural data. Any form of sub-LA mapping performed was therefore the practice of mapping rural statistics.

In contrast, participants in other authorities (e.g. Bridgend, Caerphilly) deemed it necessary to cut their data according to a rural definition to attain rural statistics; this required extra time and resources, as articulated by the following interviewee:

"It is not a simple exercise, whereas if you go to Monmouth then boom there it is, there is your rural data. You know you go to Powys and boom there it is...so for us there is much more work actually involved and I think that has implications in terms of the resources that are required to do that as well".

(B1)

More explicitly, the interviewee suggested that this caused a barrier before any further analysis could be conducted:

"So I guess kind of the biggest issue we have had is the amount of work that is involved in gathering data to together, and then analysing and interpreting it and presenting it". (B1)

In terms of rural definition, all interviewees were aware of the ONS urban rural classification and explained its application to local data. Some noted that other variations on this classification were also utilized when appropriate:

"There are two ways of looking at rural..." (Car1)

If one person has options in 'looking at rural' then undoubtedly it becomes difficult when multiple people are attempting to come to a common understanding of rural Wales. Having multiple perspectives on rural Wales is useful but could cause problems when attempting to link data together, particularly between LAs. This is interesting in terms of how LAs quantify rural statistics. If areas are grouped together, rural definitions need to change to accommodate the extended remit. This means that reorganization and grouping of local areas are associated with changing perceptions of rural definition. Adding additional complexity to a multifaceted topic.

The interviewee explained that there was also a definition linked to European funding within the Rural Development Plan. The interviewee explained how they had helped shape this definition:

"We were given the wards that would constitute for the purposes of the rural development plan the composition, we looked at them and we mixed and matched because we felt that in certain areas, some areas which were defined on a ward basis you know yourself you can have areas that are sparsely populated within a highly densely populated ward. So I think we took the view that we need to look seriously at the nature of those communities as well, the other thing some of our former mining communities or wards there, have moved there from what I would consider to be industrial-urban as they would call it to more rural, but what we have done is actually focus on what we have been given by the ONS and the Assembly and we have mixed and matched then where we feel there is a need for them to consider other additional sort of areas.

I think you appreciate that with the use of say ONS' definition, it is a very strict definition. And I think you have to look at the functionality in the context of rural urban. You know there is interaction between urban and rural and vice versa and on the edges of some of those areas you have areas, which are rural, and yet they may be in an urban ward definition. So I think from our

point of view it is literally about, yes, we are looking at in terms of what we have got but importantly we are actually analyzing that information and making suggestions that perhaps you include this as well and that as well or whatever so it's about discussion and it is about trying to come to a conclusion on where we see a rural area as being defined. But they are not a million miles away from one and the other to be honest with you, except on the edges." (Car1)

It is interesting to see how these classifications have shaped perceptions of 'rural' for conducting activity within each LA. The classification can be challenged using local knowledge of community characteristics from the perspective of LA officers.

The previous quote identified an element of 'fuzziness' in local adoptions of rural definition; perhaps this was to be expected given multiple definitions, multiple boundaries and different conceptions of rural places.

Other planning definitions were more rigid. An interview at the Vale of Glamorgan mentioned how they define rural,

"in terms of the development plan um you know anything outside one of the settlement boundaries is classified as countryside, so you could use that as a definition. The UDP for example if you look at it online and we will look at it on the hardcopy by there (points to a document on bookshelf) what you will see is that a number of towns and villages have got red lines around them and those are called either village envelopes or settlement boundaries. And in the plan we have got one of the guiding policies is about development in the countryside and the way that is defined is that anything outside those red lines is classified as countryside so you could use a black and white definition like that" (V1).

This was similar in Monmouthshire for their Local Development Plan,

"Well in terms of the Local Development Plan how we approach the county is we have what we call our five market towns. Chepstow, Abergavenny Monmouth, Usk, and Caldicot and then what we would have is different layers within the rural. We would have our main villages, which are listed, and they

have development boundaries so then everything outside is classed as rural. (M1)

This choice also enabled a degree of flexibility in their application, which in turn caused variation dependent on topic.

"Well one of my colleagues in countryside continually tells me that the county borough is 80% countryside so that means that obviously a large part of the area is classed as countryside...um the, if you like the classification we are tending to use at the moment is the one that WAG use for the RDP because obviously there is funding attached to that so it's an easy one to use". (Caer1)

This suggests that if definitions can be manipulated then so too can funding. This could be advantageous for those able to demonstrate the rural nature of places within their jurisdiction. This uncertainty in the spatial extent of rural areas could result in local integration problems if, for some reason, these disparate data sources needed to be brought together or standardized in the future.

Take for example this quote from an interviewee at Monmouthshire, when questioned about difference between urban and rural datasets an interviewee responded,

"It is all collected the same it just when it I plotted it comes out differently" (M1) "Because we are so rural...we had that request the other day from Torfaen...they think they can have the same detail. But because we are so rural and big although there is a low number of people they think they can get the same sort of detail as they could for Cwmbran. (M2)

This suggested that there are some awareness issues in terms of the difficulties presenting people in population sparse areas. These may become an issue in terms of bringing LA data together in the future.

Another issue was that definitions were subject to change over time. The ONS classification of urban and rural was often used a basis for further classification. Difficulties surfaced when the definition was updated following the 2011 Census. Not only did the definition change but so too the boundaries that contained this definition. This left several local officers confused in terms of the implications for their future rural development bids that were also subject to change.

The following interviewee discussed some of the issues involved in coming to a common conception of rural between the WG and LAs for rural development funding at sub-LA geographies:

"When they had to make the case to say it was eligible for funding, what sort of evidence did they put forward to make that case ...?" (Interviewer)

"Well they used their local knowledge about what was going on in the area". (WG2)

"So they wouldn't present a map...?" (Interviewer)

"Well a lot of them did, and one of the issues we had with it, which some of the later ones we did manage to get sorted out was that there's a big difference between rural land and rural people, and the European grant was about rural people, didn't care about land. So, you know, particularly some of the Valley authorities, when at the top end of the authorities in the Brecon Beacons National Park, but the people are down in the urban bit and it took quite a lot to try and get that concept across to them, it's quite a complicated concept so I'm not knocking them for that, but you know again once you've got those discussions going we worked out what they were trying to give us and they worked out what we wanted and we got there with most of them". (WG2)

This shows how there is somewhat of a hierarchy in terms of expertise and the degree to which people can challenge the content of the map. LAs may override local knowledge, and in turn be subject to the rules of the WG. The following passage illustrates the importance of position within the policymaking network in terms of the ability to challenge the map.

An interesting example was provided during private discussions within the WG as to what should be defined as 'deep rural Wales' (basically, a model was produced based on a drive time distance from a major population centre). A series of maps were produced by the WG's GIS section and taken to the meeting. The maps displayed options that existed in terms of drive times: 25 mins; 30 mins, etc. The question was which of these to use to define 'deep rural' Wales. Basically, from the perspective of the WG the discussion came down to what the Minister would want to see, or be happy with using. Assumptions were made based on personal knowledge of the Minister's perceived preference. It is interesting here to see how the

embedding of a rural definition is both a statistical and political act. Categories were normalized within practice just as much through political activity as they were as a consequence of statistical activities. The definition was used in further projects and funding for rural Wales (see the Deep Rural Wales Report by WRO). Mapping is used here to adhere to a political vision and appears to be a mechanism for raising awareness about rural issues but also a device for establishing coordinated action amongst rural stakeholders. Ultimately, the construction of the map and the territory it redefined was subjective and had a political purpose. In terms of the visual circuit suggested by Söderström (1996) then this demonstrates the difference between internal efficacy and external efficacy of mapping practices.

Another example in terms of choosing categories on a thematic basis with spatial consequences is within the Welsh Index of Multiple Deprivation. Here the choice of indicators is a collaborative activity amongst stakeholders acknowledged by the WG and interested parties. Basically, the availability of small-scale spatial data has a part in shaping the options for discussion.

"The WIMD 2005 - 2008 there was a big change in the housing map but it was to do with indicators being chosen and it can be a bit misleading when you publish something that is apparently the same in looks but when you delve into it there are different indicators so that is one of the problems in publishing time series data in the WIMD maybe not so much to do with the visualization side of it...? This had a knock on effect on the communities first areas that came in the top ten were not necessarily in the top ten the next time around in 2008 and they were not about to lose their funding and I think some more funding was put it but that's a statistical problem really not a mapping problem". (P1)

The WIMD is interesting as indicators change, definitions change, the population changes, the boundaries can change, the weighting can change but what does not change is the quantification method applied. Perhaps this is why the WIMD guidance recommends that it not be compared over time or between elsewhere in the UK. Given all the subjectivity in constructing the index perhaps other ways of knowing places have equal right to be within the index (See November et al. (2010) for a theoretical justification). In this sense the WIMD involves exploration, collaboration with the resultant mappings being used to coordinate activity.

The WIMD 2014 has recently been released and has several interesting addendums. The first is that it is now analysed by ONS Urban Rural classification (2011)⁴⁸. Therefore rural exploration has now come under the remit of the WG. Second a study has investigated the impact of sub LSOA unemployment by comparing OA to LSOA. Third the WIMD is now presented via an interactive display enabling users to explore the data much more interactively than before. Therefore the WG is exploring rural statistics but at the same time has changed how the classification is grouped to what is deemed more suitable for Wales.

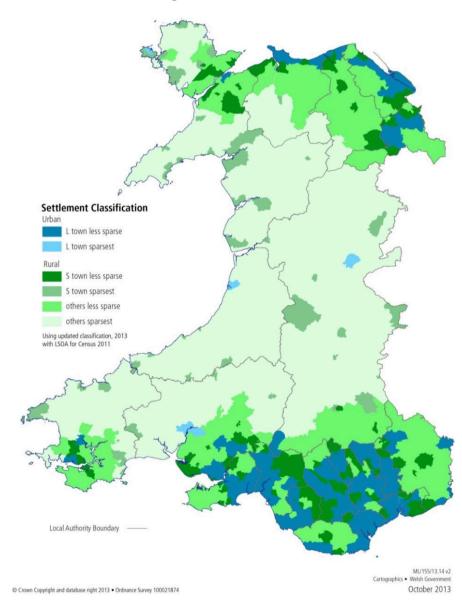


Figure 6.4: LSOAs in Wales using ONS Urban Rural Definition

(Welsh Government 2014d)

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⁴⁸http://www.ons.gov.uk/ons/guide-method/geography/products/area-classifications/2011rural-urban/index.html

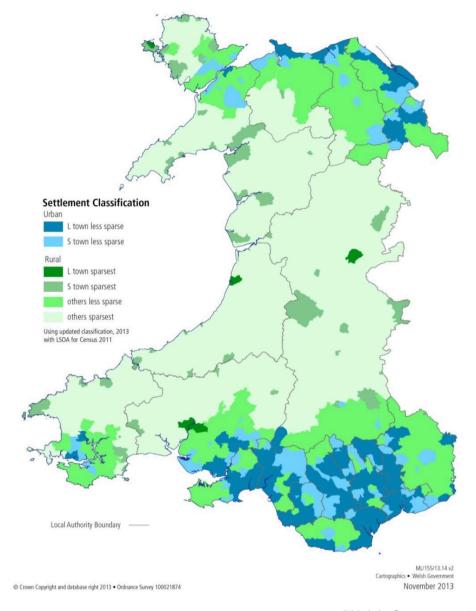


Figure 6.5: Welsh Government Grouping of Figure 6.4 to Redefine Rural Wales

(Welsh Government 2014d)

Blink and you might miss it, but there are subtle differences. The lighter blue in Figure 6.4 has been replace by a dark green in Figure 6.5. A small change but with a huge affect. Now all data released for the ONS Urban Rural classification needs to have undergone this transformation. At least, that is, if they want to align with the WG categories. A consequence of this obfuscation is that additional work needs to be performed by those also attempting explorative mapping of rural statistics. Nevertheless the WG analysis found that more rural areas tend to be less deprived. However, in rural areas, deprived people tend to be more geographically dispersed than in urban areas. Using underlying indicators and grouping them by rural

definition (the green hues in Figure 6.5) it was demonstrated that significant numbers of deprived people living in rural areas.

The second development is also linked to the subject matter of this thesis. It is a response to criticism that current methods for defining deprivation conceal small pockets of deprivation in rural areas. In fact OCSI and LGDU (2012) have argued that deprivation in urban areas tends to be geographically concentrated in certain neighbourhoods, whilst, in contrast, in rural areas deprivation often exists at the scale of streets rather than whole neighbourhoods. In response the Welsh Government (2014a) investigated the statistical consequences of using data for very small areas as an alternative method of identifying deprivation in rural areas. They use one key Census variable (unemployment) to critically evaluate such an approach. It is interesting to contemplate the results of the analysis but it must be remembered that output areas are still area based aggregations of streets and tend to be much larger in rural Wales.

The results of the analysis found that it was unclear whether output areas were more appropriate because of the trade off between data quality (because of small numbers) and the added spatial precision offered. Overall they found little difference between LSOA measures and OA. Overall rural areas tend to have lower unemployment rates, yet there were significant numbers of unemployed people in rural areas. It was noted that places that have very low unemployment at one scale might not do so at the other. Examples of rural areas that have relatively high unemployment rates when examined at OA, but not LSOA, level were identified.

"we need to challenge the assumption that analysis at a smaller level is always better than analysis at a higher level. Under some circumstances it may be so. However, there are enough data quality and other issues surrounding the use of smaller areas to make it important that the assumption is tested".

(Welsh Government 2014a)

The problem is that not many people are able to test these assumptions and in any case both definition and data are still based on spatial boundaries. As has been shown spatial boundaries can be grouped according to the whims of their creator and are modifiable according to scale. Closer inspection of the analysis reveals that this was in fact what was done (see Figure 6.6).

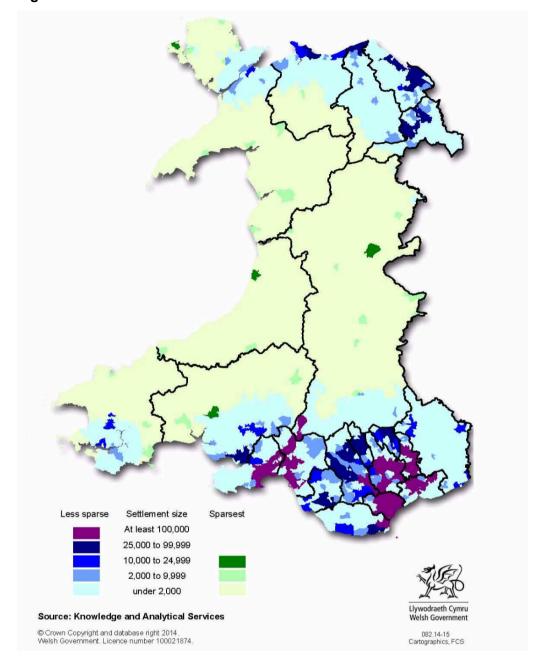


Figure 6.6: Welsh Government Settlement Classification at OA Level 2011

(Welsh Government 2014a)

Again blink and you may miss it but another layer of definitions has been superimposed. The 2011 Census data for Built-Up Areas (ONS 2013a). Again through obfuscation conclusions are presented. This type of analysis is however important because it helps to refine the statistical issues associated with mapping rural people and places. Perhaps however it would be best if these explorative activities were conducted amongst a wider audience to help people learn as well as explore.

Using the maps shown in Figure 6.7 (and with reference to the largest purple OA highlighted in the red box) the report argues,

"The OA identified had fourteen unemployed people recorded by the 2011 Census with an unemployment rate of nearly 13 per cent. The other OA in the LSOA all have unemployment rates below 5 per cent – well below the Wales average of 6.7 per cent. The LSOA as a whole has an unemployment rate of just over 4 per cent.

This raises another question. Is it important that there is a minor hot spot for unemployment in this area which contains around 300 people, especially when most of its neighbours are in the lower unemployment rate quintile?"

(Welsh Government 2014a, p. 14)

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Figure 6.7: Unemployment in Wales (OA - Left, LSOA - Right)

(Welsh Government 2014a)

Surely all unemployment (or other forms of social isolation) is worthy of consideration especially when the low numbers combined with some local knowledge could easily identify appropriate intervention.

In addition being able to link data at the household level could also circumvent the quality issues and the small numbers would be the focus of data exploration. This could subsequently be aggregated and presented at statistically valid larger geographies (and then if necessary to political jurisdictions). After all this detailed Census unemployment data, used in this analysis, will not be available for WIMD going forward until at least post 2021.

Issues such as this are not confined to the WIMD. Similar discussions take place amongst the WG and invited stakeholders when determining how to present rural Wales for Rural Development Plan funding. For example, a LA definition could be applied to focus the funding, or a Ward level/LSOA approach could be applied to spread the funding more widely. Therefore it appears clear that rural classification or definition is a 'fuzzy' topic and is not just a matter for quantification, it is an arena of negotiation amongst rural stakeholders. In Wales, it is a meeting place between national, central, local and European perspectives that together delimit the territory via the instrumental rationality of GIS. In doing so, power imbalances have been created and the future of some people is decided not just simply through the negotiation of spokespersons but also through GI availability, and the skills and knowledge of those engaged in the practice of mapping to challenge the map.

Reflecting on these quotes and observations raised important questions in terms of the appropriateness of application of rural definition in practice, and highlighted factors that can influence rural definition in Wales. The capacity to manipulate rural statistics varied considerably between LAs and evidence was put forward by interviewees to suggest that this was partly due to the constraints imposed by the collection of existing borders. Perhaps, in collaboration, groups of LAs could work together to provide sub-national rural statistics, as it was clear that national classifications of rural areas may not function so well within some LAs and, in any case, rural issues tend not to adhere to boundaries.

6.2.5 Local Barriers to the Practice of Mapping Rural Statistics

To explore this further, a series of interviews was arranged with spokespersons (in terms of mapping practices) associated with LA collectives. These actors were

already mobilized within the local networks to produce social and economic maps using existing geospatial technology. They acted as spokespersons for mapping and its wider use within the local collective. As there appeared to be a crucial interplay between the roles of the DU and the WG, in terms of establishing central and local needs, this was also explored. The results of these discussions have been aligned to the barriers outlined in the Chorley Report for the purpose of reflection and to manage the complexity of discussions.

Data Availability and Linking Rural Statistics

According to an interviewee at Monmouthshire.

"Most data is now mapped now in some form or another" (M1)

However the majority of data reported tended to be either environmental or related to the point location of a particular service.

"There is base data, what we call base date or I call base data. So OS Mastermap, the kind of stuff we buy in, aerial photography. It is just background data we use to hang everything off. You have got the third party data so we have links with CADW, links with the Environment Agency, CCW. We get all of that it but it is all sort of really driven by the individual services. Environmental health has bits of data, the emergency planning people. Then we have all our internal data, which is, then down to each individual service." (M2) "So that is where litter bins are, where bin collection routes are, we got that Tir Gofal data the other day didn't we. Your UDP polygons, Highways, Addressing, Safe routes to schools, catchment areas, councillor's areas. There was tree preservation orders, SSSIs so a big variety of data" (M3).

There appeared to be a tiered release of this data for mapping. Some went to what were termed 'specialist' GIS users, while others had access through organisation wide browsers (with limited analysis) and then on top of this there was a public interface. This was typical of most LA.

For presenting social and economic statistics, however, it appears that spatial boundaries currently present an obligatory point of passage for representing rural statistics, particularly LAs, wards and LSOA. Those working for LAs and the WG

used these units for mapping practices. As such, the wider networks within policy also become framed within these boundaries.

There were multiple political, administrative and statistical boundaries that could be chosen when mapping rural statistics; since 2001 most tended to be based on a fundamental underlying unit of area: the output area. These are constructed based on postcodes and household location and form a national unit for census data administration.

Boundaries created for the national collection of data were deemed by some interviewees to have developed with little consideration of the local applications in Wales. As a consequence, many boundaries were not coincident with relevant data collections for local planning areas. This resulted in some authorities aggregating and partitioning existing boundaries and the associated social and economic statistics to create their own areas relevant to a local problem under investigation. For example, the following interviewee explains:

"It also depends on which geographies are available for the data and whether they are fit for purpose things like super output areas were built (P2)...the lower super output areas were built without any reference to us...that was the problem wasn't it (P1)...yeah but the middle super output areas were built but they are not always fit for all purposes because they are designed for one purpose only so when you are doing something else like with the geographies we are creating for service delivery they will want statistics for them...but if the geographies they want for service delivery do not match up with statistical geographies then it gets very hard to create visual data for service delivery areas because you can't get the geography...sorry...you can't get the statistics for it". (P2)

Reflecting on this quote, it seems to demonstrate how a complex myriad of data boundaries had developed within mapping networks for policy making. It suggests that many policy problems require their own bespoke geographies. In order to create these boundaries, it would be beneficial to have access to the detailed underlying data (e.g. the location of the household and associated information). If multiple people were using a mixture of bespoke boundaries, it would make standardization and coordination difficult at a national level and might cause statistical quality and consistency issues.

When national statistical boundaries coincided with planning areas they were deemed useful. The LSOA boundary was reported to be useful for small area mapping and this was partly due to the way they had been designed. Each LSOA contained roughly an equal population count: approximately 1,500 people. Many deemed this to remove many of the representation issues of choropleth mapping. This was because each area was being compared using a similar population count. The problem with doing this for areas of population sparse areas is that the units become much larger to account for the lack of dense settlements. In addition, it causes smaller market towns in rural authorities to become dwarfed amongst much larger units.

"...so when you have got the largest town having four thousand people you end up with LSOA's covering massive areas in our rural". (Co)

The larger units were seen to be indicative of the rurality of the LSOA location:

"...because you know that a lower super output area is going to have a population of around 1,500 and then when you then map it and see the size of some compared to others you get some feel for the rurality or the sparseness of the population in those areas". (DU1)

"What it does highlight in the maps, I am thinking of Denbighshire, would be a good example if you look at the maps for the LSOA boundary you can see huge differences between the colour for say the Rhyl area and say the rest so in terms of that it visualizes the differences between urban and rural". (DU2)

In rural Wales, even output areas (the smallest geography for which national statistics are released) tended to be much larger than LSOAs in urban areas.

These new statistical spaces (i.e. super output area geographies) were perceived to have additional problems. They created unfamiliar places for policy making. According to the accounts of several interviewees, LSOA boundaries were seen to cause confusion and, in the worst cases, result in the misuse of information.

"...a lot of people do not understand LSOA and what it is because the boundaries they don't mean anything in terms of communities..." (Co1)

"You know even now like I run as part of my job I run some grant schemes and you know in that we ask for evidence of the need...they will quote back figures for the whole of the ward when actually it's one small part within that ward, one small super output area out of perhaps say five" (Caer1).

This was perceived to be less of a problem if some form of local explanation was available to the audience:

"...map only gives part of the story, the rest if it, what you're saying bringing in that local context and knowledge, it helps people relate to what is on the screen. Because you are describing scenarios that they can understand and see around them rather than just a picture". (Co1)

In this sense then rural places were being abstracted from local interpretations on multiple levels. This was done first, through the abstraction to the map (for cartography); then through the abstraction to political boundary (for policymaking); and increasingly to statistical geographies (for GISciences). This suggests a vernacular geography that needs to be considered for different mapping uses within policymaking. Vernacular geography is the sense of place that is reflected in 'every-day' language. Maybe the display of rural statistics could benefit from the application of fuzzy logic (Waters and Evans 2003) while adhering to consistent definitions and boundaries for technical standardization and interoperability.

Several interviewees appeared to have recognised the possibility that their maps may be misinterpreted and developed specific techniques in order to communicate a sense of place more efficiently. Again it is clear that emphasis is placed on communication rather than exploration. To make spatial units familiar to a particular audience, there was a need to position them next to some recognisable anchor point. Techniques included layering statistical information with recognisable features (e.g. OS map) or place names indicative of the spaces they were assumed to represent.

"...I overlaid the ward boundaries as well so that they could then see that within a ward there are those differences so that you can match the two things up if you like so people can see visually ok well that is the ward of Aberbargoed but within that you have got you know four LSOA's and only two then are in the most deprived category". (Caer1)

This was interesting as it showed that there was internal signposting required within the map display rather than what the map abstracted of these places. Another interviewee also spoke of the need to translate these scientific spaces to a vernacular geography familiar to their target audience.

"If you have an LSOA [Car3]...nobody knows what the hell you are talking about [Car1]...nobody knows what it is but in the ward you do not know what area of the ward it is so we have put in a locality name so people can know roughly where it is [Car3]... Even practitioners themselves find it difficult to understand...if we go all out with this and make it a publicly available site, then Joe public, whether it is the expert or whether it is the individual living in the particular locality, wouldn't know where they are in the context of a code. But they would know where they are if you just put down a couple of key areas. Now we have developed that ourselves, colleagues in the Assembly asked us what do, we do, because they were also finding it the case that because arguably they did not know where the heck they were talking about at that level". [Car1]

The recent move towards InfoBase Systems results in maps becoming detached from these local explanations and techniques. Maps increasingly require the Internet as a medium to exist and function and work at a distance within the confines of the software. As such, the resulting maps can be detached from their local contexts and tended to operate alone as a seemingly scientific measuring device. However, as has been explained, maps are far from scientific (Monmonier 1996). Without local explanation or guidance it was possible for maps to be misunderstood when decisions were made at a distance. This was especially the case for those unfamiliar with the places and information being presented. At least in a report there would be text to support the map.

"we are always very keen to include the names of the villages, the sort of key roads so then it is actually something that people can relate to but when you start getting too abstract that would make sense to us but I imagine that some people... well they would say that is not where I live so its about how people relate to it". (B1)

If maps and GI increasingly become exchanged over the Internet, a map user will have little or no contact with the sources of the map (unless of course they are the

same person). For this reason, metadata becomes increasingly important for providing these local explanations. However the subject of metadata was rarely mentioned during interviews. In any case metadata can only ever explain so much about GI or a map, as not all explanations are selected for the purpose of efficiency. This makes metadata necessarily sterile and devoid of the stories needed to understand these local places, great for data linking, not so great for understanding people and places. This highlights the difficulties of treating maps, and in fact GI, as one-way communicative devices. This suggests that mapping could benefit from being a collaborative activity between multiple, interested stakeholders and used as a sounding board to help to better understand the complexities of rural spatial problems. As noted by Montford (2008) human interaction around maps is beneficial and Maceachren and Brewer (2004) have established a framework to enable this to happen.

So in terms of the Chorley Report, it was not that data did not now exist on many broad policy themes, it did in most cases; existing data still, however, failed to offer the fine detail required for exploring local issues and setting local targets. For example, data may well exist on household income but if an interviewee wanted to investigate this for particular age groups, family types or in particular areas it became more of a problem. Existing data could only take them so far. This was even more problematic if, say, a LA needed to extract rural information on this type of topic. The additional filtering (if possible) resulted in small population counts. In addition, if the topic studied was only likely to be experienced by a small portion of the filtered population, the mapping issues were intensified. Then even data aggregated to a higher spatial geography, such as LA, was difficult for certain topics (for example, unemployment levels in the APS). This means that when policy indicators were developed at a national level, there may be an imbalance in reporting ability at the local level because of their inherited spatial data units. Presenting and exploring rural statistics using mapping is therefore even more difficult for some LAs and this hides rural issues. As a result many National Strategic Indicators have been developed that are blunt tools for exploring rural issues but are becoming more accessible via web interfaces (such as in Figure 6.8).

Welsh Government National Strategic Indicators Viewer Home Indicator Analysis Summary English / Cvm Period: 2013-2014 * Mode:

From average

From quartile 60 50 40 77.51 30 20 10 Powys 100 80 60 40 20 2009-2010 2008-2009 2010-2011

Figure 6.8: National Strategic Indicators

Welsh Government 2014 (http://data.wales.gov.uk/apps/nsi/)

Rural Issues in Sample Surveys

Mapping was used in practice to deal with the detailed social and economic data provided by the census and was to some extent shaped by it. This detailed information was available infrequently (ten year cycles) and soon became out-of-date for tackling policy problems. It did, however, provide an important benchmarking tool and could be used to calibrate many policy instruments. Despite its uses, the ten-year cycle meant that there was a requirement to collect and utilize local data using sample surveys in the intervening period. Other small area administrative social and economic statistics were available (e.g. DWP) and these could be supplemented with national government and local surveys. Therefore these could be incorporated in quick desktop mapping investigations. Recently SAIL and the ONS VML have provided additional bespoke services but access to these data is not straightforward and awareness of their service appeared limited in LAs, as they were not discussed

Whilst the WG routinely used sample surveys, to provide information on a wide range of topics (for example, employment, health, sport), they are by definition sample

surveys⁴⁹, with associated sampling errors. Additionally, and unlike the census, they are not always able to supply accurate information for local populations (unless a booster survey is used to increase the local contingent or multiple waves of the survey are aggregated over a period of time) especially at a neighbourhood level. There appeared to be a trade off in terms of accurate spatial data (required to explore rural issues) and frequency of collection, which is undoubtedly balanced by funding.

This meant frequent sample surveys were better placed for tackling national issues in general rather than exploring specific geographic variation of a phenomenon. As a consequence, unless specifically targeted at rural Wales, sample surveys can rarely be exploited to explore local rural issues. The following interviewee expressed the issue:

"...a lot of data, um, if it comes from the national level which is the most reliable and developed level of information it isn't always available below the local authority level so if we wanted to look at those areas that have been defined to rural as opposed to the town areas then that isn't always possible unless there has been a booster survey in that locality or whatever and you know which is rare we have to pay for stuff like that we don't really do that". (B2)

This is particularly problematic for Wales, as some LAs tend to be much larger in spatial extent and have to deal with quite separate issues in different parts of that jurisdiction. As one interviewee explained:

"The purpose of getting the information is so that we can plan better and if you can only get it at a county level you may as well carry on with what you are doing". (Car1)

As result, there was potential for social and economic issues to become masked when using a national or LA statistic in isolation without any supporting contextual information.

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⁴⁹ Sample surveys are also voluntary and can, at best, expect a response rate of around 80 per cent (March, 1993).

In LAs, that contained a mix of settlement types and sparse populations; the interviewees indicated that it was difficult to separate 'rural' issues from those that affected the rest of the authority. The following interviewees noted this:

"DWP benefits data is done on a ward and LSOA level I think so you have got that but everything else, the APS, the Business survey and things like that we haven't got the data to visually represent it at anything other than at the Bridgend county level...the national level data is on a Bridgend county basis and because we don't have a majority of rural wards, um, rural population therefore you know it would be unjust of us to use Bridgend statistics to talk about rural issues in Bridgend". (B1)

"I don't think really we make any differentiation we are not like rural as in the sense of Powys do you know what I mean all our area is...none of our areas is really remote then, so I think from that point of view we don't really make any kind of difference between rural and urban because it's too small an area to need that, as I say if you are Powys then obviously that would be a big issue". (Caer1)

Important social and economic characteristics of people living and working in Wales will be hidden when using LA statistics alone. Alone, they provide a blunt tool for exploring population sparse areas.

The issue was that if bespoke geographies were constructed locally from sample surveys using small units, such as postcodes, then due to low numbers it was possible to identify individuals:

"With some stats we have obviously got statistical disclosure issues where the numbers are very small that doesn't tend to be because the population itself is small it's when you are looking at a very narrow type of issue". (B2)

This can be resolved to an extent by aggregating the data to higher spatial units. In most cases, the units required to be statistically robust were the size of LA in any case. Then the usefulness of thematic mapping becomes questionable and other data visualization techniques may be more suitable (Bertin 2010).

Another option would be to invest in a comprehensive information gathering

exercises related to specific policy topics at a local level. This would come at a cost and there would be potential for these surveys to become ad hoc and uncoordinated, resulting in the duplication of effort and resources. Data, visualization and funding appear interrelated in that increases in one can cause an increase or improvement in others and vice versa. However legislation related to GI can intervene.

The tradeoff between showing local detail and adhering to people's privacy clearly makes explorative mapping difficult in rural areas. Sample survey data can be used to drill down to smaller geographies but comes at a cost to the organisation. With increasing savings needing to be found within the public sector, it is unlikely that detailed surveys capable of providing this will exist in the immediate future. In any case, sample surveys are particularly problematic to map because the data needs to be weighted to help remove bias and the effects of missing data when aggregated for a spatial area. What is gained through survey techniques is paid for in a host of generalist assumptions (albeit statistically sound ones). Moreover this means that mapmakers not only need to be knowledgeable about GI, geospatial technology, and mapping techniques, they also need to have the qualities of a statistician. According to Harris et al. (2014) there currently a shortage of these skills in the UK.

As a consequence, in practice many policy practitioners utilize datasets on themes that only touch upon an issue without really being able to get to the heart of the subject matter. Too much is being read in to too little. Policy issues are being addressed as much by the assumptions and interpretations of key actors as they are through exploration of the quantitative evidence. There is a lack of policy relevant quantitative detail within rural areas. At present, GI seems to be available in a contextual format for local areas but nothing much more, at least not for policy-making purposes. If data is not fit for purpose, it may result in its inappropriate application. It might be fitted to a scenario and mask the real issue. As such, this suggests that mapping should not be conducted in isolation and form part of a mixed methodological approach or perhaps a springboard for further investigation rather than a solution in itself.

"...the qualitative side of it as well...you need to be focussed you need to be clear in your mind what you are looking to achieve, it is almost the case in some instances of working back from the answer, and I hate to say it but it is and you work back from the answer tell me how can I gather the information I need to tell me there is a need for this that and the other..." (Car1)

This suggests that maps were being used rhetorically to evidence particular needs rather than displaying objective outcomes (Pickles 1995; Davies et al. 2002) despite superficially appearing to do so. Almost providing an informal currency for political debate. Other LAs had also reported how they had used mapping to highlight the needs of the LA for funding and had used the larger spatial boundaries to their advantage.

"It's not necessarily the best visualization we used it for a campaign for a funding bid here to quite good effect...you can see that Powys stands out...well we made it stand out didn't we...so that is a copy for you it is very much a sort of document where we chose the statistics that supported the case...so that's not like producing statistics for an evidence base for a strategy that was for supporting a funding bid...we are not ashamed of that no that was the requirement to produce evidence to make a case for extremely rural area that often gets overlooked particularly because it's sandwiched on the east side of Wales between urban areas and when figures are produced in the NUTS 2 areas of West Wales and East Wales our case gets overlooked...so this was a campaigning tool really". (P1)

The interviewee presented the report that contained a map with a large circle of stars surrounding Powys on the cover. Inside there were numerous examples of maps in which Powys was presented to stand out.

So it seems that rural policy issues cannot be targeted using mapping alone - unless of course they are being used as a marketing tool. Maps appear to be more useful for backing up an argument than a scientific tool for exploring rural areas in policymaking networks. In this case maps appear to be used as a tool for propaganda (as suggested by Monmonier (1996, pp. 87,139)). Maps did so through emphasis and selectivity whilst still adhering to cartographic conventions and using statistical units.

Information Overload or an Issue of Scale?

As multiple boundaries existed for which multiple data were collected, it created another problem for representing rural Wales. What boundary could and should be used? As was noted earlier, the choice of boundary plays a large part in how rural places become represented in the mapping process. For those translating this

information for the purposes of policy making, a myriad of options existed but all tended to be built on the same small area geographies. For interviewees social and economic information within these areas needed to be transformed from a state of complexity to something that engaged an audience and was presented simply. This created something of a paradox as, by summarizing information, much of the important detail was lost - the detail required for demonstrating a rural issue. Too much information and the audience were lost. Therefore, an important balancing act needed to be performed. Ideally, the goal was maximizing engagement whilst minimizing unintentional misrepresentation⁵⁰. After all, it would be a massive waste of resources if the information provided to policy makers was being ignored due to it being overcomplicated.

One interviewee suggested that if too much information was provided, it left the organisation in no better position and perhaps jokingly warned of 'paralysis by analysis'. The interviewee further explains this by suggesting:

"You can end up totally failing to see the picture out there because you have collected so much information and really at the end of the day you still don't know what the issues are". (Car1)

So it seems that too much information is problematic but so too is not having enough; the middle ground would be having enough information to tackle policy problems at an appropriately detailed spatial scale⁵¹ to evidence local needs.

Several interviewees acknowledged the importance of boundary choice for representing sparse populations:

"If you're using the polygon data to visualize things then the selection of your particular polygon set needs to be made with a full awareness of the, you know, of how appropriate it is to do that". (WG1)

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⁵⁰ However the purpose of the map may just as well be to persuade or exclude (Crampton 2010)

⁵¹ It is important to keep in mind that not all policy issues have a geographic dimension.

There was little evidence found of how the suitability of spatial boundaries were assessed by LA participants and, regardless, in many cases it was used because it was all that was available on a certain topic.

When interviewees were using different types of boundaries, there appeared to be a need to muddle through and settle for what was available rather than what best represented the underlying population. This trade-off was necessary because most data was available for larger spatial units, units less likely to correspond to the location of population-sparse settlements. These larger units were simple to comprehend but also most likely to be misinterpreted unless local knowledge of the area could somehow be incorporated In contrast, data collected for smaller geographic areas correspond more closely to settlement patterns. Considerably fewer topics can be mapped for these smaller geographies due to a lack of data collected at this level. Perhaps they are of less political importance representing only thousands amongst millions however add them together and there is an issue.

The difficulty for outlining rural statistics on the map was that the detail was required and this required small area mapping. One interviewee suggested there was the potential to have too much going on at once within these types of map-creating confusion rather than understanding, as noted:

"I use these a lot... I am not sure that that one is a very good example because is it LSOA's for the whole of Wales...to me it looks very busy and a bit too much but we do use choropleth mapping a lot usually based on wards occasionally on LSOA's or postcode depending on what geography we have got the data for...because in the rural areas we have a problem because the rural area is covered by a small number of wards, one strategic area, and a small number of LSOA's so trying to draw a choropleth map of our rural community is quite difficult and we end up sometimes using postcodes or something like that..." (Co1)

This quote illustrates the reliance on the different predefined boundaries used to partition Wales for policy making purposes and illustrates how these can prove problematic at a local level. There appeared to be a tradeoff between usability and accuracy and information transfer.

When choropleth maps (such as those discussed above) were shaded, according to the quantity of a particular variable, there was potential to provide an illusion of a phenomenon being evenly distributed about that area. This was an issue that had been commented upon:

"The trouble is your eye is drawn to the blocks of colour and the blocks of colour are largely where people are not so you're going straight for the wrong thing". (WG2)

This suggested that mapping, in some cases, could be misleading even when using small area geographies. This appeared to be a representation problem that could occur at a variety of geographic scales; most notably when using larger administrative boundaries, such as unitary authorities, to represent rural population - as explained below:

In Wales you've got this whole problem of, you've got the problem of Powys, that it's something like, don't quote me exactly on the figure but it is something like 25% of the land of Wales and 3% of the population, I'd have to look the figures up properly, therefore whatever is happening in Powys looks like it is a pretty important component of what you've got going on in the whole of Wales. Whereas you can't see Cardiff". (WG2)

This scenario was quoted many times during the fieldwork and termed the Cardiff/Powys problem by several interviewees. The problem hence appeared to be a relative one; a problem of displaying spare and non-sparse populated regions in the same way on the same map. However it also appeared one of perspective. This phenomenon did not just exist for LA boundaries, it propagated down to lower geographies - as the next quote emphasises:

"...you cannot hardly see that Llandrindod East has got higher benefit claimants compared with all the others because of the tiny geographical size so this is a problem and I suppose in the WIMD people in urban areas got really upset about the vast expanses of red when there was very few people actually living there for like the housing domain...not the housing the access to services...um and they would so it's a question of scale...the scale does not always work does it...its challenging". (P1)

So for smaller spatial boundaries then, the problem still exists but to a lesser degree and there was less awareness. This was possibly due to the problem as it was affecting even less people (see Figure 6.7).

Another issue exists because within geospatial technologies larger geographies can be used to 'cookie-cut' or define smaller geographies. Therefore, postcodes may well be officially allocated an ONS urban rural code but may be redefined using larger spatial boundaries. For example, postcodes that fall inside the LSOA ONS urban rural may well be allocated this code or perhaps even the Rural Development Plan code. They may also be divided into LAs and a LA definition applied to these postcodes. Therefore in one scenario all postcodes in Carmarthenshire are rural while in the other only some are. Therefore, the ability to overlay layers adds to the complexity of definition and highlights the difficulties caused by the MAUP and the ecological fallacy (See Chapter 2).

On the surface, it appears that mapping rural statistics is largely a technical issue, an issue that occurs on multiple geographical scales. If this was all there was to the case, then solving the issue would depend on a number of technical factors alone. These technical factors that would require rethinking include the location of the existing settlement distribution on earth relative to boundary size, boundary shape, boundary quantity, and boundary connectivity (i.e. how boundaries are placed relative to other boundaries). In addition, this would need to be considered alongside another important component that translates itself upon the choice of boundary, the way in which the quantity of the population of the phenomenon under investigation is subdivided and apportioned. This, when combined with a particular colour scheme, can influence the overall appearance of the statistical map. All these technical factors are however, and as noted earlier, the outcomes of human decisions, the agency of the mapmaker and their influential network of associations. This is where mapping practices are forged and all these elements are drawn together. The mapping of rural statistics is not just a technical problem alone as it can be easily superseded by choice. Perhaps, then, diverting attention to activities outside of the screen can also go some way to providing a solution.

So to summarise, it appears that despite initiatives that have advanced the availability of data for the UK, in general, the benefits have perhaps not been so widespread in Wales. A deficit of accessible social and economic data for small-area mapping remains. From a quantitative perspective, in practice this restricts how rural

areas can be geographically represented for policy making. In addition, in attempting to overcome these issues, multiple collections of spatial boundaries have developed causing confusion for those outside the mapping network within policy making arenas. Hence presenting a problem that changes with scale but also through a users perspective and interpretation.

Research, Education and Training - Sharing Knowledge

There was a limited pool of individuals mapping social and economic statistics. As a result information sharing tended to be ad hoc and informal. However this lack of capacity also meant all information needed to be channeled through them before any policy value could be added. These few formed the local network collective that used mapping in policymaking processes.

Within the network of those interested in mapping, it was evident that certain implicit techniques had emerged for visually representing social and economic statistics in general. Kitchen and Dodge (2007) refer to this as ontic knowledge when it emerges from within the cartographic discipline. There tended to be an implicit top down approach. When describing their best practice, an interviewee at the WG demonstrated the development of this knowledge:

"One of the ways that I like to use these and I do use them quite a lot is to make sure that you've got map and table together..." (WG2)

The interviewee explained that this was because using the map alone was sometimes misleading, as there was no direct correspondence with the underlying population. The interviewee continued:

"...and against your 5 categories, whatever it is, it is five, you've got right this account is for x percent of the people so that you can see all that very dark brown stuff that's actually only 5% of the population, even though it comes out and hits you." (WG2)

This was with reference to the fact that the dark brown regions on the map appeared to be mostly shown in larger units within the map. The interview continued to provide advice on what they considered good practice:

"Another technique I like to do with this, I don't claim that any of this is definitive, I think it's quite a nice trick that you actually set up your categories so that each one has about the same number of the group of interests, the people over 64, and then when you look at the different colours, well each of those is about the same size" (WG2).

Note how techniques are referred to methods as a 'trick' in this quote. It alludes to the ability to control what is being seen within the map by the manipulation of the visual variables.

During the interview, it also became apparent that many mapping decisions had to be based on a human judgment; a human computer interaction rather than an automated process:

"One of the problems with this and where a lot of people go wrong is that the choice of the bands is so important in what you see and too many people just let the machine decide and machines are bloody awful at doing that". (WG2)

As many of the stages of mapping within geospatial mapping technology had become automated, it enabled a much wider audience to access maps without developing these skills. In addition, it was explained that these choices could not be overly prescribed as they could vary with the topic and with the type of map or graphic:

"You've got to have a good reason for what you do, I mean you don't want to be too prescriptive about what that reason is it, it will change chart to chart, map to map. But, have a good reason for doing it and you know...it's the old trick that we should all be doing really, this map is supposed to show, have a look at it, does it...sometimes you think...no it shows something else and actually that something else is more interesting but you know it is a tool you have to use". (WG2)

Notice the reference to tricks again. Regardless, what this quote suggests is that best practice guidelines could be provided to map producers to lower the chance of misinterpretation by their intended audience; however, these guidelines would need to be less prescriptive and more to raise awareness that there are certain production

stages that need to be carefully considered.⁵² Moreover, it would require frequent updates due to the changing nature of the discipline. Perhaps this guidance should also emphasise HCI procedures for exploring the GI.

The following interviewee suggested that to present maps of rural statistics required skill or it caused representation problems:

"...it takes a lot of skill to get a good one of these. They're too easy to produce and that is the problem I think, and there are some real stinkers out there because of the Powys...you know Powys compared to Cardiff type problem". (WG2)

If decisions are increasingly being made based on human computer interactions, and these processes are opened to widening network through increasing automation, many maps will be produced without ever being seen by another person. The problem is if all these interactions are based on fundamentally flawed representations, they are never available for wider scrutiny and may never find their way into the public realm aside from the resulting actions of their creators. But what if this temporary map-based HCI was 'a real stinker'? This situation highlights why static map-based representations are still important for policy making as these are currently one of the only means of documenting the stages of explorative map-based decisions. Without these maps, there will be no workings from which to learn.

According to Cosgrove (1999), the instrumental use of maps in daily lives can obscure the epistemological and interpretive challenge that mapping presents. Is the ubiquity of maps in our daily lives now leaving the maps used to direct them unquestioned?

The ubiquity of maps was a cause for innovation in some LAs who were using Google Maps and Street View to engage new audiences (e.g. by plotting 'green' tourism assets) and develop novel ground truth techniques (e.g. using Street view to check homogeneity of housing types to challenge the boundaries of output areas).

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⁵² Note that the WG has officially outlined what is considered best practice in terms of dealing with rural Wales in their report – 'A Statistical Focus on Rural Wales'. It says much about rural Wales and how it should be classified but little of the techniques for exploring and presenting these statistics within maps.

Monmouthshire noted how they were using social media and Geo RSS feeds for layering public data. However they noted how licensing and copyright issues inhibited progress and integration between OS and Google Maps. Providing an example of how they wanted to map bus routes and journeys but his gave away their rights to the data.

Education and training in GI appeared a crucial component for improving policy making decisions about people living in rural Wales. There was a limited collection of individuals capable of working with different forms of GI within a GIS let alone operating the GIS itself for performing spatial analysis. In some cases, even when trained individuals existed in LAs it appeared that the GIS component of their role only constituted a minor part of their overall responsibility.

"Work divided in to 70% policy 30% GIS, although my main responsibility is policy officer I am often burdened with the task of GIS work because there is no corporate GIS section". (A1)

Even LAs with corporate approaches to GIS tended to use mapping for operational tasks rather than to explore social and economic GI for making strategic decisions.

Education and training is therefore still a topic that needs to be tackled to improve the practice of mapping social and economic statistics for policy making, which has become commonplace, particularly for understanding rural places. At least then informed choices can be made about how to visually represent people living and working in rural Wales. This education and training should not be limited to staff working at an operational level but should be taught throughout the organisation as best practice. This should be made a matter of urgency if all policies need to be 'rural proofed'. GI and GIS are not straightforward topics and, where this appears to be the case, is often where errors can propagate.

The problem is that there is a sharp learning curve from the skills needed to produce a location map and to the advanced statistical techniques (for examples see Figure 4.2) and GI knowledge required to perform geographic regression and search for spatial autocorrelation mainly applied by academics. The majority of maps in policy making tend to be towards the basic end of this scale: the thematic map. The quantity or proportion of a variable is shown at a variety of locations or the relationship between variables at locations is investigated. It was unclear whether

this was due to the limited skill base or that these were the techniques most pertinent for policymaking⁵³. Aside from these technical skills, there was also a depth of learning required to understand the consequences of quantifying social and economic statistics and understanding rural places.

At present, there appeared to be an increasing demand for GI for policy making. This increase was not reflected by the number of staff within public sector organisations trained in mapping and knowledgeable in the unique requirements of GI.

"The big draw back with a lot of this is that it has to be maintained and kept up to date. You have got a fair resource that you need to put in to it and obviously from our perspective we do have to try and ensure that we keep it up to date as best we can. I will hold my hand up and say we find it difficult at the moment given the resources that we have because it is one man and half a dog, not even a dog doing this work and the issue from our point of view is that we need to sort of build on this information that we have got by directing people to other data sources as well". (Car1)

It is clear that education and training for current staff was not a priority:

"We did have a research day once when we were part of the research and information team with GIS. We used to be able to take a team day once a month and set ourselves topics, which is a luxury long gone..." (P1)

Instead, the solution appears to have been to provide new tools to siphon interested parties towards collections of GI than are automatically represented within themed choropleth maps. This is illustrated in subsequent sections. Without being trained or educated in GI, it will still be difficult for those in policy making to navigate their way to the information they require.

Policy makers with weaker relationships to the mapping network may also need to understand the types of GI that exist and where these can be accessed quickly and simply, particularly as more people become aware of the mapping in general. This

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⁵³ LAs appeared to want to demonstrate where their services were located; assess local needs and send policy messages whereas the WG used mapping to for coordination and directing funding.

will require raising awareness and careful signposting, as discussed by the following interviewee:

"Yesterday we had a guy who gave us a healthy bit of grief as far as I understand it, he couldn't find, on the Carmarthenshire stats site reference to the areas of community councils, well of one community council in Carmarthenshire until we pointed out well here is the link. These are the sort of things you know we do tend to...perhaps it needs to be more visible possibly than it is possibly on the council's website at the moment...and that is the only issue I do have on it." (Car1)

Having common central databanks is a more marketable solution and should make these types of processes more efficient and straightforward. Moreover, reducing the burden of dealing with routine tasks from the few individuals able to manipulate GI within GIS could potentially enable more effort to be devoted with the difficult task of representing social and economic issues spatially, and for rural Wales. In addition, the reduced time allocated perusing quantitative or spatial epistemologies themselves may mean that there are other important issues that are no longer overlooked or not fully explored. A more triangulated methodological approach to understanding rural places may be possible.

A lack of coherence and stability in all levels of government must contribute to limited advances in mapping rural statistics. Not only are people moved in and out of roles, some roles persist over time and make it difficult for new positions to become available. Limited budget appears to be allocated to developing new or existing mapping roles. This may be fine in the short term but may create more long-term problems as skilled personnel leave their positions or are moved away from operational positions into managerial roles. When they do, new positions will be created but there may be an issue in terms of knowledge transfer and succession of activities.

At present, there is a decreasing public purse and as a result fewer specialists are needed to deal with an increasing portfolio of problems. As a consequence, the time and funding for GI education and training is being squeezed. This is all coming together in 'a perfect storm' where the number of skilled staff members are remaining static, or in some cases reducing; at a time when the need for GI to respond to policy

issues is increasing and becoming ever more important as described by the following interviewee:

"What is really focussing the mind at the moment is the fact that we are into significant resource constraints and arguably to make the pound go further we must ensure we know where to target so we get better value for what we are doing...the days have gone when you can actually use a scatter gun approach, you now have to be focussed and meet the need out there, with the limited resources you have available and in order to meet that you need behind it the collection of evidence to tell you what the need is as well as the qualitative side of it as well it is not just statistics for stats sake". (Car1)

The interviewee provides an example of how the GI evidence-base is increasingly becoming embroiled with policy.

"In the context then, of evidence base from our point of view, quite critical. We are doing some work right now on health and social care and beyond the well being strategy, where it does require the evidence to actually come out with specific priorities, specific recommendations and specific drivers for the future in an environment of finite resource bases. Much, much more important now than it has been for many years and the evidence base is so critical in a lot of this, rural areas in particular because obviously of the sparsity side of it". (Car1)

This LA provided an interesting juxtaposition of staff with roles related to GI and GIS, some close to the end of their career while others just beginning. The LA provided one of the few examples where additional staff had been employed to help map rural statistics. The interview described how they had begun work developing sustainable, rural hubs for the LA:

"Currently there is a lot of data, some data is there and some is not for certain things so it is about bringing it together into one map really is the idea. So rather than having to look at several maps to get to a conclusion it is about getting it all there in one dataset into one possibly interactive or something map. So that you can see straight away where these things are and also to inform people themselves really in these areas what they have actually got. There might be a lack of education in certain villages, one village has got a

post office but people don't go to that village because of other issues..." (Car3).

This was a clear example of where important decisions were being made in terms of service provision for rural people. It was quite surprising to note that this person had only been in the role for two weeks and had therefore had limited practical GIS experience; although it was reassuring that there was at least some sort of succession within GIS related roles in Wales given the increasing use for policymaking.

Another example was found in Gwynedd.

"We will be employing somebody within the next few months specifically for developing this aspect of our work...as part of a larger programme I think of changing the way research and information is used and communicated within the council. We will largely be looking at very local data such as paycheck, mosaic and point topic which is information about broadband use and take-up and it is about trying to combine those things at a local level...the data will be mapped as it will help us identify and maybe try to understand why people are behaving in a certain way and it will also hopefully allow us to target the councils resources to places where the resources are most likely to have an impact" (G1).

This interviewee also appeared to have close links with academic research at Bangor University.

The decision of where and how to allocate services in rural Wales is important especially at a time where some services are being withdrawn. The following interviewee explained:

"It is almost a case of you are not able to spread the jam as widely as we used to so basically what we are doing is spreading the jam to areas that people can all reach". (Car1)

This is a case where maps can have an important role in shaping decisions or might also be used as a tool to justify a decision that has already been made. It demonstrates both the use and problem with mapping for policy making. Mapping can frame problems,

"...All our pupils, where they live is mapped and their schools mapped. What were we doing the other day? With the social services, look at domically care, trying to change they way that they provide services. They are trying to rationalize the number of different providers and make better use, so it becomes more efficient and lower cost" (M2)

According to Sheppard (1995) this framing of a problem using GIS can divert attention to away from perhaps more important matters such as why services are being withdrawn in the first instance.

6.2.6 Summary

The preceding sections have outlined benefits, limitations and barriers in the practice of mapping rural statistics. Many have been beyond the control of officers working within LAs and some even beyond the remit of the WG. As part of this research project, it was important to move beyond these broad issues and begin to understand how the complexity of the situation unfolds in day-to-day practice, as it is here where mapping and decisions take place often without ever being questioned from outside of policy practice. The remaining sections explore the detail of mapping practices and emphasis will be given to the similarities and variation in mapping practices that take place even within the same rural LA: namely, Carmarthenshire.

6.3 Variations on a Theme - A Detailed Study at Carmarthenshire

Many have noted how the circumstances within which current mapping practice exists makes it difficult to detail the clear demonstrable benefits from using GI and GIS. This may limit the resources managers as willing to devote to this type of activity. The tangible outcomes of GI and GIS activities may not always make their way into final projects to be demonstrated. Instead, they remain hidden but an important part of decision making at an operational level without being fully realised by those working in more strategic roles. Where examples of good practice emerge, they tend to be piecemeal, and fragmented.

To pick up this issue and explore some of the potential consequences in terms of practice, a LA was explored in detail. The focus was on specific mapping practices

and map pathways. Carmarthenshire was used as a detailed case study and key individuals were observed during social and economic mapping practices.

It became clear that despite having the same data; the same software and a similar organizational network, clear differences had developed in the way mapping was taking place. For some, it was a technical exercise in terms of managed GI; for few, it was tool upon which to explore spatial scenarios; for most, it was a convention used to communicate information; for others, it was an output (regardless of background processes) to be used as evidence e.g. funding. Each of these divergent mapping practices were found within a LA collective whose practices converged in terms of their use of the 'map metaphor'. The places shown in the spaces on the map linked the practices within the organisation.

Two of these cases of mapping were particularly interesting, as it was evident that the mapping practices varied in style based on experience and training. These practices will be illustrated in turn and the potential consequences for the mapping of rural statistics will be highlighted. In addition, there was a Regional Learning and Skills Observatory where mapping was conducted in a collaborative manner between several LAs (including Carmarthenshire). This will be discussed in the final section. Next the two contrasting mapping practices will now be outlined based on the experiences of two people using social and economic statistics in Carmarthenshire.

6.3.1 Communicative Mapping

The first of these interviews was conducted with a policy information and resource officer at Carmarthenshire Council. Here, mapping was mainly focussed on representing information about the characteristics of the population within the council boundary. The interviewee was also involved in the LAs' preparations for the release of 2011 Census data as described:

"...in terms of putting everything in place ready and then a dissemination strategy to look at pushing the information out to people to make it sensible for them to let them know what it is and whatever. That then is cross-departmental within the authority and in fact it is across five authorities in South West Wales. From Pembrokeshire through to Neath and to Bridgend actually. We are working together to ensure that we share information and whatever on that front". (Car2)

Therefore there was some evidence of resource pooling in collaboration with neighboring authorities.

The interviewee described the unforeseen circumstances that led to additional responsibility for research and mapping within the council.

"I took over, and I just followed on really, from what [he/she] was doing, doing the mapping and things, the same as what he was doing". (Car2)

This interviewee had been on secondment to help with a number of aspects of the research work for the LA. The interviewee was now responsible for presenting statistics for the corporate policy team.

The interviewee described the main part of their role in terms of policy making; creating the evidence base, consultation and engagement. These were seen as the key areas where social and economic statistics had a role in describing both the county and comparing between other parts of the country.

An example was provided of where an evidence base was required for the 'needs assessment for the county'. This involved working with partners in neighbouring LAs and also with public sector bodies, such as health and the police, to provide a common template from which to coordinate activity.

"So we are getting all the evidence together to see...because people think that they know what is needed in their areas, but evidence will show, and data will show that it might be different to what they think". (Car2)

This statement was interesting as it highlighted a potential arena of conflict where local knowledge and common sense may contrast or be overridden by the application of GI. If maps are used to present this GI then clearly the way GI is presented has a role to play in this debate. Especially if the argument resorts to what is deemed more scientific or objective evidence.

"The way I use these maps is just a visual, sort of, so they are not just looking at tables all the time...it's just for them to be able to see it a bit clearer...because sometimes, for people instead of just seeing figures, and

seeing the tables, if they can visualize what it looks like, it makes it easier for them to understand the process". (Car2)

It is clear here that maps are being used to convey a message, a communicative tool, rather than as a method to explore the data in more detail. It was used to engage audiences with the statistics. This may be in part because of the level of mapping experience of the interviewee.

"I had a MapInfo course which was run for two days, um, which was very helpful. But, I think you learn more from fiddling around, and experimenting yourself, and, um, it took me a while before I was confident enough...the first few reports I did went out without maps because I wanted to get them out but now I am quite confident, I just update the table every month and its fine". (Car2)

This suggests that there is an issue. There is a need to build organisational capacity in GI handling and mapping for dealing with social and economic datasets. Not only this there should be a commitment to ongoing professional development. This needs to be addressed especially if the roles of practitioners are frequently changing or additional statistical responsibilities are being subsumed within roles. Without having the training to explore rural statistics in more detail, there is more chance that maps are taken at face value and not interrogated or questioned.

However, with a tightening public purse it is unlikely to foresee how improvement can be made within this area unless there is some sort of pooling of resources. At present, LAs appear particularly vulnerable in this area:

"It's resources isn't it, you know...at the moment, I am the only one doing anything with stats in the corporate team." (Car2)

Clearly, in this circumstance improving software, techniques, and so on, has limited value if there is nobody in a position to take advantage of them. Additional funding in these areas will have limited benefit in terms of improving practice. Instead, training and education should focus on how to take advantage of the technology that currently exists. Improving the fundamental knowledge and awareness of GI and how the specifics of application within certain scenarios, e.g. rural mapping:

"I think the last year has been a very big learning curve for me, and there are so many datasets available that it's quite overwhelming, you know". (Car2)

However as explained earlier with regards to rural statistics it is not just about finding data, it is about ensuring that data is appropriate and its limitations are fully understood.

The interviewee explained how the new role involved the task of routinely representing Job Seekers Allowance data for the use of officers in the council as well as the cabinet executive board. When asked why there was a need to map JSA claimants and interviewee stated:

"I think this was decided before my days in this post, to be honest, it was an ongoing requirement, especially within the economic development section, where they are doing a lot of regeneration things. They can see where, maybe, certain vacancies are required...you know it helps them a lot". (Car2)

It was interesting to see how mapping routines had become established and partly embedded within the organisation. Mapping practices were being replicated as an ongoing commitment:

"it was done previously by, um, the girl who did the job before me, so I had an idea of what she did, and what was needed, so we just carried on from there really". (Car2)

If rural statistics are not explored in these habitual mapping practices then replicating what has been done previously is unlikely to reveal any 'hidden' information within the data that might otherwise be revealed through data exploration.

The interviewee was asked to detail the stages that took place in order to produce these routine maps, similar to those depicted in Figure 6.9 and Figure 6.10.

Figure 6.9: Map of Wales from Internal Mapping Document

(Showing Job Seekers Allowance Claimant Rates for LA)

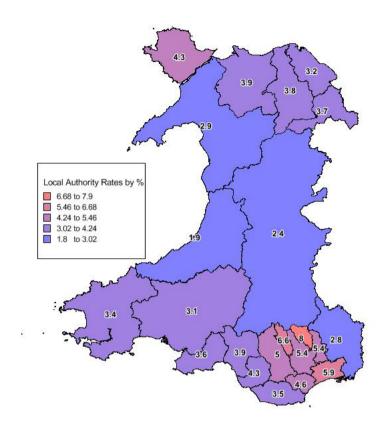
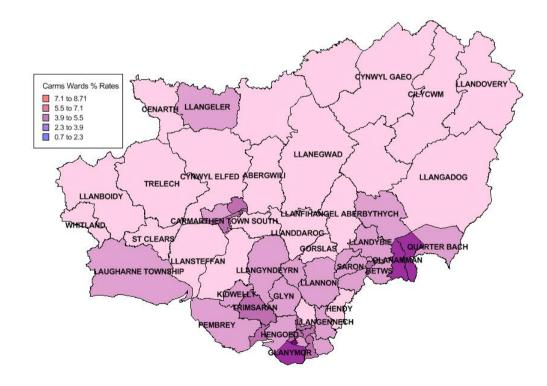


Figure 6.10: Map of Carmarthenshire from Internal Mapping Document

(Showing Job Seekers Allowance Claimant Rates for Wards)



The interviewee began the description:

"Before I create the map, I need to ensure that I've got, um, all the, um, areas I want to map the data for, er, done, in the format that MapInfo requires them, so every area's got their own specific code. So, you have to make sure the code and the name are exactly as they are in the map table that you're using. And, then, um, I update the rates and the claimant count, and then you have to open your, er, map table". (Car2)

Notice how the interviewee appears to be adhering to the rules of the software rather than making the software work for them. If these initial stages of map production were automated (such as in the InfoBaseCymru systems and their local derivatives), more effort could be devoted to interrogating the data.

When asked how much work was involved in this initial stage, the interviewee stated:

"Um, no, not a lot, because, um, we've very lucky, on our server, all the maps are there for us, so I just have to download the map for Wales or the map for Caernarvonshire, in their wards. And the table's, sort of, there for the map on our map on our server, so, um, I can work on that, then". (Car2)

Therefore, the majority of information would be held centrally and local copies of the data were made on local workstations. It was on these local stations where practice began to diverge. Selection, in terms of what is represented in the map, was affected not only by the map creator, in this situation, but also by the person in control of the central data repository for the organisation. As the interviewee explained:

"You can't do anything on the server for it, because you could be changing the map for other users". (Car2)

If changes were required to the central data stores, this had to be negotiated with the people responsible for the corporate GIS system. The alternative was:

"To copy them to your, um, computer, and then you can attach the data you write...the table and the workspace". (Car2)

Therefore, those with a desktop GIS can create the framework for mapping data by downloading all the relevant data to their local machines. The next stage then involves getting the social and economic GI of interest:

"And then, I get, I copy the data from NOMIS, I get all my JSA rates from NOMIS. And, um, I copy them in. I make sure that my Excel sheet from NOMIS is in the same form, um, format, um, same, um...same mode as what the table map is, so that they match, and the right data is going into the right area". (Car2)

Next, there is a stage of checking the data; the interviewee discusses this practice for wards as shown in Figure 6.10 and LAs, as shown in Figure 6.9:

"Usually they go in in alphabetical order, but we have some, um, ward areas in Caernarvonshire, for instance, Saron, St Claire's [ph], St Ishmael's [ph], for some reason, St Claire's and St Ishmael's would come before Saron. Because it's the S-A, so I have to make sure that those are in the same order... And the same with the Wales one, the Vale of Glamorgan comes before Torfaen, so you've got to swap them around, maybe, before you map them, then". (Car2)

This suggested that the data was being linked without using the specific code allocated to the ward. In addition, this type of detailed checking is time-consuming and difficult the larger the number of areas that need to be checked.

"Um, then, once you've got your Excel spreadsheet, fine, and you're opened up in MapInfo, you have to import the Excel spreadsheet, um, into MapInfo. And then you have to attach the table to the map...and then you get your map...as you want it, you create a thematic map". (Car2)

It is clear that within the stages described so far, there is not much need for human intervention aside from to check for errors and this could be avoided with use of automated procedures using unique identification codes; there is little mention of the appropriateness of linking JSA or mention of metadata. Although the interviewee notes that this does not take much time, it is perhaps time that could be better spent exploring the data and assessing the metadata.

The interviewee explains how maps are produced with minimal additional analysis:

"I haven't done any analysis of things, um, you know, for, um, many subjects, I haven't had the time, to be honest, but I would like to be able to do a bit more of that". (Car2)

Once all the data and information was brought within the Desktop GIS, the interviewee states:

"Well, you start to think, you, you see what sort of ranges would best show the rates...and the colours. Um...put too many ranges in, it just gets too, too busy, and too cluttered". (Car2)

It is interesting to hear the term 'best' as it suggests that the interviewee is working towards some form of optimal map. Moreover from whose perspective is the range selected considered 'best'? The interviewee appears to conceive the map as a communicative device rather than an explorative tool.

The interviewee continues and describes how this is done on the screen:

"You've got a section in the mapping for when you create the thematic map, you go in there, and it'll ask you what sort of ranges you want? Equal ranges...or you can devise your own. So... Equal ranges, I do, about five of them. And then... Um, yeah, there's five, five there. And I usually try and use the same sort of colours, like, um, a very pale colour going up into a darker colour...so you that you can show it a bit more clear, yeah. So, the pale colours would represent the higher rates". (Car2)

There is a lack of consistency in application here that might cause confusion - take for example Figure 6.9, the colour scheme in this map does not match the map for wards (Figure 6.10), despite both appearing sequentially within the same policy report. In the thematic map of Wales (Figure 6.9) the higher values for LAs are represented by pinks, and lower values by blue/purple. In the map in Figure 6.10, the pink colours appear to represent lower values and the purple higher, however it is not clear. In addition, in Figure 6.10, the colour scheme in the map does not correspond with the shades in the legend and the breaks in the data were different. This suggests that maps presented in a certain way can sometimes raise more questions than answers. However, the fact that it starts a debate in terms of that topic might be useful in itself as long as it is picked up. Several guides have been produced for these purposes but they do not appear to be used in practice either due to a lack of awareness or because of a lack of time.

Once these options had been finalised, the interviewee shared the map. The interviewee stated:

"You have to save it, um, you save the workspace, er, and you save it as a jpeg, and then you import it into the document". (Car2)

The final maps were inserted in a document with associated tables to show differences over time as well as rankings and rates within the county. To produce maps for this document, an additional stage was needed:

"Um, sometimes, I will put it into Photoshop, and I will crop it, you know, to, to get the best sort of quality to put into a document...because sometimes when you're doing the mapping, MapInfo, you'll have, um, some spare white space around it. So, I always take it into Photoshop, then, and crop it, so we can get, get it as, um, close as possible in there. And then we, I import it into the document, and try and make it as large as I can, and as visible as possible for it to show the colours in a better format. Um, not too large, because you don't, you don't want the document to be larger than necessary. You want the information there, but you want a visible aspect that they can just look at, as well". (Car2)

Note that by enlarging maps outside of the GIS, certain aspects of the map may no longer function as expected; for example, the map's scale. The maps presented in this case did not contain information on the scale of the map but in practice this is a potential source of error.

When asked if anyone else collaborated to help produce the map, the interviewee replied:

"No, no [laughs] I'm just basically a one-way shop, yeah". (Car2)

The interviewee assumes the role of map maker here but much of the map making has already taken place to a large extent, for example, the availability of geographic borders; the organizational need for the specific GI; the software and its preprogrammed functions; the projections, and so on. Instead of explorative mapping, this is more akin to a repacking of existing datasets. The only choices that have been made appear to be the colour scheme and the choice from a selection of predefined breaks for the data distribution.

At present, the reports that contained maps were then circulated throughout the council using a mailing list.

"They would go to the Chief Executive, to the economic Development section and to many heads of service...it goes to the Scrutiny and Consultancy section of the Council, Flexible Business Support, a lot of the councillors who are interested in it, if they've asked for a copy, they will get a copy...a lot of these were on the list before I started my role". (Car2)

The reports were also circulated outside the council:

"A lot of outside, er, organizations, as well, contact me. If they're looking for grant funding on things, you know...they might need a copy of this." (Car2)

Therefore, it seems that these reports that included thematic maps were then diffused without much feedback to the original map producer.

Providing Feedback

As part of this research it was interesting to actual obtain feedback from others on the actual maps produced. As each participant had been chosen for further interviews based on their usage of JSA claimant reports regularly produced by the research officer at Carmarthenshire Council, it was useful to gain their perspectives on the type of mapping used in this report. The maps contained within the report are shown in Figure 6.9 and 6.10.

"I mean, I will admit, what I tend to do, um, with my mapping, like by colour, I tend, like, to stick with the classic, you know, red/green indicators, because it, it's got more of an impact. So, you know, where, where there's this mosaic, um, Carmarthenshire, this is unemployment percentage is it? Um, so, you know, where unemployment is high, er, I'd rather just go with the red to get it in, in people's mind that, early, you know, and where, where it's much lower go for a softer colour. So I tend to use green, green to red indicators, you know, it's, because we are using a lot of different environments, so you may as well get it in people's mind that there's an issue to address...er, if you know what I mean. So, um, to me, I wouldn't use the same colour palette, er, for, for a single colour palette, if you know what I mean. I'd rather just have green to red and have the, the impact immediate". (Car5)

In this account, given the choice, the interviewee would use a different colour scheme and appears to associate red with bad and suggests there to be a

psychological element to map use. Both observations are similar in that they appear to suggest the map as a communicative device. What this helpfully illustrates is how mapping practices are uncoordinated and suggests there to be multiple mapping 'voices'. Meaning that different people could produce multiple maps of the same data and none may look similar.

When asked to comment on the labeling, the interviewee stated:

"It's, I'd say it's fair, it's fairly clear, but, I mean, they're, you know, I'd say, we know, because it's an environment we, we, sort of, know, we know roughly where the wards are anyway but there are gaps missing in some of the wards, wards listing there..." (Car5)

Another interviewee added:

"And this data, I guess, would be re...you know, in terms of our presentation of support embedded it would be just be re-engineered in a certain way anyway". (BF1)

This shows that preferences and techniques vary within a LA. Lack of consistency was not just limited between different teams within the LA; there were differences even within teams when it came to the same map.

The RLP explained how each team member had a particular take on how GI should be represented.

"I see it that everybody's got a different learning style, so whether that's like your kinesthetic learning, your kind of visual learning, every, each one of us in this room works in a different way, and that's what like that does. That gives you the visual. When you go and do something you're doing your kinaesthetic, you know, and then it's just basically teasing that out of people without you actually realising that. You do find when people go on the observatory when we've done training sessions that there are some people that go straight for the data maps and take the data maps. And then some that go straight for the table. It's very, it's not, they don't question it, they just go like that". (SW2)

"It happens and just in the group that we work in, so you'll have (SW1) and (SW2) that normally work on tables, myself will go straight to a map. And then

you'll have somebody else who'll be audio, that needs to hear it as well, so that's the way I kind of see it". (Car5)

If there are these differences of opinion within one map then explorative mapping could benefit from being undertaken in collaborative arenas for debate and would require new types of working practices. Some element of consistency is required in order to explore social and economic statistics but this should not be at the expense of being able to display the same GI in multiple ways. This is where a coordinated approach is beneficial but only if the representations contained within these systems can be adjusted to meet the needs of a particular audience. If this was possible then modules could be loaded into these systems better suited to displaying rural issues without the current limitations imposed by political and administrative boundaries. This situation described above, using maps to communicate to an audience, contrasts with the next form of mapping, despite both being within the same LA.

6.3.2 Explorative Mapping

The following interviewee was a former member of the GIS team in Carmarthenshire Council; then moved to the Research and Coordination and, at the time of the interview, worked as part of the Children and Young People partnership. A fellow colleague noted that this interviewee provided:

"...excellent work in actually taking forward the GIS and thematic mapping aspects for our purposes of statistics really for the purpose of forward planning and targeting resources and generally sort of focussing in on areas of interest like for example deprivation, rural deprivation and then obviously access to services, issues and things like that...and sort of link it in with sort of joined up thinking in the context of where in the future do we, you know sort of put our services where we have characteristics in a local area that suggest that we should but targeting there or there or there and so on so you know". (Car1)

Clearly, this interviewee had become established within the LA for undertaking mapping practices. In terms of qualifications, the interviewee had a degree in Psychology and a Masters in Human Geography and Research Design.

The interviewee was currently involved in providing evidence for strategy development and guidance in terms of the activities required to take care of young people in Carmarthenshire. The interviewee described a 'live' project that involved collaboration between the WG and Carmarthenshire Council: a targeted Early Years programme to assist families with children under four years of age in deprived areas of Wales.

"Oh this was the very, very start, I mean Flying Start is a Welsh Government initiative and it's based on getting children in deprived areas to have the same opportunities from better off areas because you know that from say age two to three children from more deprived area start lagging behind, when children are born health visitors assess them about being capable of this and that and then they get an 18 months assessment, by the time they are three, that assessment can be reversed by deprived socio-economic conditions. So the Flying Start initiative is to get equality in opportunities and get more stimulus into young children's lives. There's another element of it in these areas they will provide free childcare so that the mother can access, or father can access training to get work. So you know it was helping in a number of ways, stimulate the child and provide free childcare". (Car3)

The interviewee provided evidence of how mapping was used to determine where to allocate additional 'flying start areas' within the LA boundary of Carmarthenshire.

"I was involved in identifying the first areas and I'm not saying that they were 100% but they did sort of fall in the most deprived areas so looking at the criteria at the time. This time the Welsh Government said the first criteria they wanted us to look at was income benefit households where there were children aged 0-3, in those households. We were given those by lower super output areas. So this is the database they sent us". (Car3)

The interviewee then presented an excel sheet listing the LSOA in Carmarthenshire and a column containing the proportion of income benefit households containing 0-3 year olds within each LSOA. The interviewee had colour coded the rows the excel sheet according to certain criteria. For example, if it was already known that work was underway in an LSOA, the row was allocated a particular colour (hue) and, likewise, if LSOA's fell above or below a chosen cutoff point, as described:

"They give us, the raw data, you know all this colouring is mine. So we did it from 50.7% which is the highest proportion and as a cutoff point I said I'd look at 30% and over." (Car3)

When asked to describe how the cutoff point was chosen, the interviewee responded:

"We were, those also come into it, but it was looking at the first thing was instinctive, let's not go too low, let's not go too high, let's go and see where we are from here ...". (Car3)

Here, mapping was much more an interactive and explorative process that involved testing the breaks in the data; then investigating the map and then assessing and if needed further adjusting of the breaks within the data.

"It's based on looking at the areas, I'm thinking well yes, yes, and I just going to see what it goes like because we had to have a starting point". (Car3)

This process involved knowledge of the local area; knowledge of the data and how it could be manipulated, and also a degree of trial and error. An iterative process was undertaken to explore possible scenarios; stored through manipulation of the data; then assessed in terms of what was known about the area and the policy programme. Although on the surface this appeared a private activity, it was still framed by the data and the technology available; the policy programme requirements (hence the political agenda), and the interpersonal working relationships of the interviewee.

This interviewee had the skill and data to conduct explorative mapping below LSOA level to investigate small-scale variations when deciding where funds should be allocated.

"When they give it to the people in Flying Start, because I'd worked on it the first time they came to me because when you're looking at the database it's not even sorted, they said where do we go from here and I said we look first at the LSOAs and because of the numbers of the children we were allowed, I think it was 940, there was no way we could add in whole LSOAs. But whole LSOAs vary so much they wouldn't hit the criteria". (Car3)

The interviewee explained that geographies below LSOA were explored and demonstrated that the locations of households and information at postcode level were available and utilized for this project:

"Because we could never have included the full LSOAs. We were only looking at postcodes within those LSOAs, otherwise we would only have probably put two LSOAs in knowing that they're very deprived areas, so we said we'd look from there up..." (Car3)

This is the type of detailed analysis that would help reveal hidden deprivation in rural parts of Wales. This type of explorative mapping takes the data that one step further and although still dependent on area measures explores the variation within LSOA. In addition, it looks at particular characteristics of people within the household. However, postcodes are not designed for this type of analysis and vary in extent especially in population-sparse parts of the country. At present, however, no other form of data exists (that was widely accessible) at this small scale and the GI used in this analysis was actually a commercial product and was based on a modeling process.

"Yeah, I mean when you hit on one household it's not data for that household, it's data pertaining to that street built up out of many different data sets that Experian buy in from a lot of places, you know, but we've never had access to this detailed data before, so it was very useful, I mean housing have used it for their project and because you know when people say, you know we were getting our numbers of children from the health authority for each post code, so as we were getting near to limits, we knew we couldn't put more housing in, in fact we had to go round removing house, I mean post codes not houses, sorry, so if I was taking out a postcode it would be more likely to be that one than that one, so it was just a totally objectively based on data in front of me, not what I perceived the street to be". (Car3)

The decisions were perceived to be objective but the extent to which this is possible is questionable. Firstly, the data itself is not objective it has been created based on many commercial decisions as noted in the quote; secondly, selection of GI brought within the GIS to make the decision is a subjective process; in fact, so is using GIS as tool to make these decisions. There are undoubtedly many other elements that make these types of decisions subjective, however, informed judgment based on the best available information is surely better than doing nothing, guessing or attempting

to corrupt the map? The main problem that existed here is that these explorative investigations, based on map-mediated decisions, are processes that are not easily replicable in practice even with clear documentation.

The interview demonstrated that the data GI held within the GIS and interacted with the information during the interview while thinking out loud.

"But that was our first criteria and the ones in pink were existing Flying Start areas and that's what I'm saying, we've got some down here that are existing Flying Start areas that wouldn't have fallen into that". (Car3)

The interviewee displayed an LSOA map of the LA jurisdiction:

"So we looked first at those, we came up with ten LSOAs that were between 30% and over income benefit households...what we've got is the brown areas are the LSOAs that we'd identified". (Car3)

The LSOA within the map were colour coded according to the selection criteria. Next, additional datasets were superimposed to further investigate these LSOA as explained:

"Then all these were added, coloured patches, I was adding areas in and looking at other factors because we had the Welsh Index of Multiple Deprivation, thematically mapped that so the darker red areas were more deprived". (Car3)

These made little sense as demonstrated but were understood by the interviewee. The interviewee then zoomed in on certain LSOA using the GIS and displayed this postcode information, as the interviewee explained:

"If we zoom in when we're identifying certain streets to put in, and certain streets to...this isn't the finished one this is a work in progress. I'll show you now. Those are the streets, these here are the post codes ..." (Car3)

This postcode data was allocated to all households within the street so that each street of houses was deemed homogenous.

"We bought in, we didn't buy in, we were very lucky, housing bought in Experian data...and what they do, it's colour coded up to 100, but we just go

eight to naught but by colour coding them the same, when we were looking at post codes only..." (Car3)

The Experian postcode data enabled sub-LSOA criteria to be assessed for the identification of eligible postcodes. In addition, the location of households was used to assess where certain ineligible households fell on the border of an eligible LSOA or postcode but were deemed suitable for inclusion due to the settlement structure.

"The second criteria we also looked at we were allowed to extend existing Flying Start areas and I'll show you something where that was, you know that helped a lot...the blue and the very green areas occur up here and so if you're looking at street by street, you know if you worked in that pink, that would be the ones we most want to add, now the green are existing clients in that area and what people had been complaining over the last seven and eight years, is we live that side of the street, they live that side of the street, why aren't we in it, and yes, it's a post code lottery because of the numbers because it would be lovely to add everybody in but what we had to do was down here this was the...the green was the existing, this, these were very poor conditions on par, so we could add those few postcodes in, but we didn't want to add those ones, this was on the mosaic data but they were, that would have been extension to existing whereas...I'll turn these off for in a minute, because it's too much...up here...oh this is a little thing...this here is a very, very big council housing estate and it had been the health visitor were always saying why are these people excluded, they're exactly the same condition so under the criteria add into the existing we completed the estate but this area of Dafyn was putting to under the income benefit households that hit the criteria there...so because health visitors do things in areas we added in those areas both as an extension to existing and so they could join up here". (Car3)

Note how these are difficult passages to interpret without the associated visuals to accompany the narrative. At the time, it made sense but it is quite difficult to communicate this information within text. It becomes a long, confusing and laborious task. The point to take from the passage is that practical and local logistical considerations become enrolled within the mapping process:

"Yes, and it makes it easier for working for them, plus they all have a centre which is usually a school or an integrated centre that they work from, you

know where they provide child play, child care and the courses that they run...we know...we've only got three integrated centres and they highlight the schools, the green dots would be the schools so I would say they're working from that one and then the different post codes in there, these...it was then saying "oh we won't put that post code in, we'll put these in" and it was..." (Car3)

Therefore, the location of services and their service areas were also included as part of the decision making process. This type of mapping triangulates spatial data sources to provide a more rounded representation of community circumstances. However, despite this, all is framed within the confines of the methodology adopted.

A difficulty was that much of these decisions were lost in the final presentation of the map. These interactive spatial decisions were many and varied. The final map presented to the wider audience was simply a summation of previous mapping processes. As a result, the final map only displayed areas determined suitable for funding. Much of the hard work was hidden.

However, the interviewee explained how, in this case, the mapping process was in part a collaborative activity:

"Yes, I would send in first of all doing a jpeg of it and emailing it and then every now and again we'd have a good couple of hours and go through it, sitting here...we had all different colour coding because normally in addition was the patronage of Managers so it was easier to, I was adding hers in and colour coding it and so I knew exactly which was from where." (Car3)

It was interesting to see how colour was used in a different way here compared to in Section 6.3.1 as part of a collaborative exercise. Despite a host of literature on the use of colour in maps, there was limited literature available on application in this type of context. It seems new visual guidelines will need to be produced for geo-collaborative mapping practices. These need to be made available not just to the academic community (Maceachren and Brewer 2004) but also translated for exploring maps for policy making.

Geo-collaborative mapping is not such a 'quick snapshot' but more a narrated and animated story. Mapping is a performance (Cosgrove 1999; Crampton 2009). If managers and stakeholders are not involved in these explorative processes, it could lead to an underestimation in terms of the amount of time, effort and resources

required to get to this final map. If mapping is treated as a collaborative activity supported by someone trained to operate and manipulate social and economic GI, it opens up the process to a wider audience but retains the explorative capabilities of specialist GIS packages. Geo-collaborative interactive mapping therefore offers an alternative to the InfoBase model, which presents social and economic statistics in a finished communicative format. Therefore, each dataset is explored but the ability to overlay and look within and between different spatial scales is lost. These functions are important for representing social and economic statistics in rural Wales as they help to reveal issues that would otherwise remain hidden if spatial statistics were taken at face value. Regardless the InfoBase model provides a building block upon which these practices can be designed.

6.3.3 Summary

Several interviews were conducted within the mapping network at Carmarthenshire. Some provided data for mapping; some were users of the output of mapping processes (See Appendix K). The two examples presented in this section help to demonstrate the variation of mapping practices. In reference to model presented by DiBiase (1990) mapping was mainly about visual communication in the first scenario (6.4.1) and an iterative process of visual thinking and communication in another. The map uses would fall within opposing corners in the cartography³ diagram by MacEachren and Taylor (1994) but both eventually became about communication to the wider public. Both practices resulted in a map used within a policy report, which hid quite contrasting actions. At the same time there was no consistency in the application of visual variables (Bertin 2010) used within these processes. This suggests that not only is there a need for detailed data to explore rural issues, there is also a need for consistency in representation in a multi actor environment, in addition there is a need to look outside the map and develop appropriate mechanism and training to understand not just rural GI but also rural places.

6.4 Changing Mapping Practices in Wales - The Data Unit

Following key actors operating in the local network in Wales enabled the study to investigate how the DU, as a collective, had positioned itself within the network of those involved in using social and economic statistics for policy making. It had done so by offering a solution to several of the many mapping barriers outlined in the Chorley Report. It did so through its InfoBase product and the services offered

associated with this product. Where there were problems in mapping social and economic statistics locally the DU offered a solution. It was designed to enroll a wider audience by offering an intuitive mapping solution to those using evidence and less specialized in mapping. As such it was progressively replacing the type of mapping discussed in section 6.4.1 but had less to offer more explorative mapping activities such as that found in section 6.4.2. In this sense it was increasing the communicative mapping in a robust and consistent manner. The DU was perhaps unknowingly embedding a way of visualizing social and economic statistics, at the same time normalizing a way of representing rural people and places in Wales.

6.4.1 Data Unit - InfoBase Systems

Within the InfoBase systems, pre-packaged maps were made available. Much of the data gathering tasks had been completed and the social and economic data came already linked to spatial boundaries. In the opinion of the DU, this reduced the need for education and training in GI and geospatial technologies. These systems also helped to improve coordination by defining common standards. In terms of the Chorley report then it was removing many of the barriers.

Originally, InfoBase was used to present the Welsh Index of Multiple Deprivation¹. The organisations position within the network became unstable when the WG took over the duty and brought the product in-house. The DU responded by emphasizing the other social and economic datasets available and prioritizing their service to LAs. Since the InfoBase systems have functioned as social and economic data portals that have mapping capabilities (see Figure 6.11) and have their data maintained by the DU. InfoBaseCymru prioritises national data for Wales (example on left) and more recently local systems have developed to focus on local area statistics (example shown to the right). Much of the data held for Wales in InfoBaseCymru is provided at the LA level. Value is added in these systems, for LAs, when small area geographies are presented. An interviewee emphasized this:

"Its draw back is knowing how Conwy as part of the country compares is part of the picture but we want to drill down to much lower geographies because we got part rural areas part urban and we want to know what are the specific issues in different areas not for the county as a whole". (Co1)

Therefore by providing a local service, the DU was able to enroll the interests of LAs more so than before. In doing so, the DU also mobilized the interests of local partners whose activities were being aligned with the work of LAs under the guidance of the WG. This meant that the DU was able to redefine its role within the network.

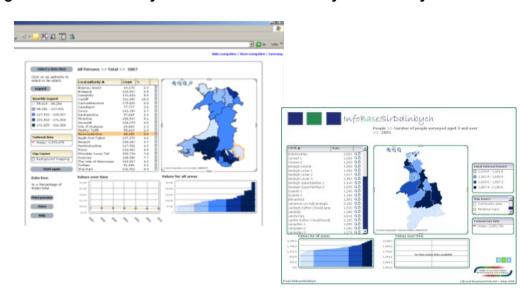


Figure 6.11: InfoBaseCymru and a Local Authority InfoBase System

The DU acts as a central data repository for Wales, with their clients having their additional data managed by the unit but with their own custom built interface. At the client end, there are several 'live' and dynamically linked components. These cause the display to change based on the client's interaction with the elements contained in the interface. Therefore they can click on a region within the map and see the corresponding position of that region in a graph, line chart and table.

The DU, as a collective, had procured the geospatial technology and in doing so associated themselves with the interests of the software company, the social and economic data (and therefore all their providers e.g. ONS) and the spatial boundaries (and their originators e.g. OS) in fulfilling a role. Each of these operated via the Internet and so each component could act at a distance in providing a service. This service was juxtaposed between the demands and needs of the WG (and more broadly the UK Government agenda) and LAs (and their network of associates and partnerships). Within these systems, choropleth maps had become the *de facto* visualization mechanism for information transfer. Essentially then, the underlying data has become 'black-boxed' within an interactive mapping tool. In doing so, the

fortunes of social and economic statistics and spatial boundaries have become intertwined and embedded within the networks that use these tools.

6.4.2 The Introduction of InfoBase, a Web-mapping tool for Wales

In terms of the development of the InfoBase systems, the interviewees explained that there had been an initial search to find suitable software to match their requirements,

"We looked around then and we could see that GeoWise and InstantAtlas were becoming the front runners in terms of mapping software that met our requirements..." (DU1)

When questioned as to what the requirements of the DU would be, the interviewee replied:

"Geowise seemed to fit in terms of price, in terms of how it was already beginning to be used for observatory type um settings if you like and I think we were impressed by their plans and their ideas for moving the system forward, also one of our key requirements was that we had to have a system that had that would be able to provide bilingual and that was a key requirement for us so that does limit your scope". (DU1)

From these initial statements, a number of undercurrents appear to emerge from the discussion. Firstly, the choice of software appears to be market driven with cost, and the fact that it was currently in operation noted as factors in whether to utilize the software infrastructure. There was no mention of the technologies' appropriateness to represent underlying geographical phenomenon. It was interesting to listen to how these systems had been given the role to act as a vessel for GI. The assumed logic between the system and the data had quickly become unquestioned. This did not appear to be a theoretically informed decision and had enrolled the DU with the interests of cartographic community.

There also appeared to be political and legislative factors that limited the choice of system, specifically in terms of providing an interface that was bilingual in English and Welsh. Clearly, the Welsh language issue is not something that limits choice

within all countries, although bilingual systems might be required in Europe. Regardless, this appears to highlight that the initial choices were constrained by both funding, and a narrow market when it came to bilingual software. There was no reference to any insight gained from literature that looked at similar types of diffusion of geospatial technologies within organisations.

The DU suggested that their organisation was a pioneer in establishing Webmapping tool for policy making in Wales, as explained below:

"As an organization we have been a partner in the developing and updating of the Welsh Index of Multiple Deprivation...we were probably one of the first organizations around Wales then to try, to use mapping then to try to display the deprivation indices". (DU1)

At the time, there were other examples of Web-based mapping used outside of policymaking. For example, in England, Jason Dykes, an academic, had been working on Web-based cartographic visualization for over thirty years¹. In addition, several LAs had already begun to develop their own Web-mapping solutions albeit in a static map format without interactive functions e.g. Powys i.

Local systems were piloted as a test for housing social and economic data for LSBs. Therefore by enrolling the interests of LAs they were in turn mobilizing allies in the broader public sector network. As there was a cost associated with these new local systems, there was acceptance by some of the potential of these systems but others resisted and failed to buy in to the local InfoBase systems. In addition, some LAs were already busy mapping rural areas within their jurisdictions and so there was potential for the local InfoBase Systems to threaten positions within the network.

6.4.3 InfoBase in Practice - Regional Partnership and Observatory

Distributed forms of mapping have already been discussed in the literature review. The InfoBase systems have moved towards this model but cannot yet be classed as fully distributed systems. Instead they offer what has been classed as diffused mapping. Diffused mapping has been chosen as a term to refer to a situation where preliminary mapping is undertaken by an organisation before it is diffused to a wider audience using a common Web-based HCI. It is possible to interact with elements within the GUI (e.g. to band the spatial units or to change the colour scheme) but the software and the software's custodians can limit this choice. It is similar to distributed

GIS but lacks the flexibility to perform spatial analysis (e.g. overlay, network analysis, proximity) and alter the background processes.

In many ways, diffused mapping was similar to existing corporate mapping practices within most local councils in Wales, where local area networks were used to disseminate GI between departments. Diffused mapping differs, because although GI datasets are held centrally, they are stored for multiple authorities, held externally by another organization and diffused to each local user via the Web. In addition, elements within the interface can be graphically linked and animated. Unlike the majority of LA mapping the focus is social and economic statistics, not planning areas or point locations of services.

The DU, as a collective, acts as a central node for these local mapping services. These services are geared towards revealing the proportion of a certain social and economic characteristics using a collection of standardized spatial boundaries. The DU acts as an intermediary in terms of access to GI. It supports local bodies where they have weaknesses and in turn positioned itself as a central player in mapping statistics for Wales. These mapping processes again appear more concerned with communication than exploring the given data.

In Carmarthenshire, diffused mapping of social and economic statistics could be accessed using InfoBaseCymru at a national level but also through LSB insight. The interviewees suggested that health, social care, and community development were being prioritized within the work of the LSB partnerships that would have access to LSB insight. Therefore, in addition, the SW Regional Learning and Skills Observatory (also based on the InfoBase model) had been developed to focus on education and regeneration. This eventually became the Regional Partnership through the inclusion of additional LAs and eventually also Powys. The Regional Partnership will now be discussed to provide an exemplar case for diffused mapping.

Regional Partnership and Observatory

The background to the Regional Partnership was discussed. It formed seven years ago as a partnership between a few LAs in the South West Region. Since, it had grown to a collaboration between six LAs:

"Yeah, this is, originally it's out of development from basically Newport Talbot, because the chair of our strategy group up until very recently has been the Director of Education at Neath Port Talbot. And basically he came up with an idea to look at, looking at partnerships in terms of local education partnerships. There's different ones across the entire region, so the idea was to have an overarching one to basically provide support to all the other smaller networks and partnerships". (SW1)

The interviewee explained how the RSL observatory emerged from this partnership and how this was advantageous for a collaborative working environment.

"...the reason for the observatory is one of the pillars of the Regional Learning Partnership was to bring together data to compliment the national models that are out there, the national databases that are out there, but to bring together a lot of all the data sources that were relevant to education region, scales, in one uniform place for easy access, and to try and bring that element of local data, even down to LSOA level". (SW1)

The interviewee described how all the partners data was brought together which was perceived to facilitate collaboration and avoid duplication:

"I suppose, objective of the partnership is to avoid that duplication. So working together, you know, across the stake, with the stakeholders and the partners to ensure that we're not duplicating, we're not all doing the same piece of work, but we'll do it collaboratively, we'll do it together". (SW1)

The RSL observatory provided elements of the data bank to the DU and identified national datasets that could also be used for this work package. The RSL observatory had a specific target audience as outlined by the interviewee:

"The core users were after our user information in applying for funding, or making decisions based on statistics basically. So we're trying to make it easily available and sort of accurate to them, that's the primary audience". (SW1)

The key audiences and partners were working between the six LAs. These organizations were outlined and included higher education and further education, Career Wales, Job Centre Plus, Chambers of Commerce and the third sector. The aim was to bridge the working practices between education and regeneration. The

audience was not limited to these bodies however and the observatory was also used as a learning tool for schools in the area.

It was clear that the purpose of the observatory was partly to instigate partners to start using the evidence to make decisions.

"It is getting information, statistics and that sort of thing into the environment of decision making first of all...but then also moving on to presenting it in a, in a certain way then..." (SW1)

There are difficulties here, however, because if sector specific observatories emerge in Wales and specialize in certain aspects of policy it becomes increasingly difficult to challenge the maps that they produce as a collective, as they become established as the experts on the topic. A lack of competition or challenge to existing practice could subdue mapping innovation. There are nonetheless clear benefits to this observatory based mapping approach for example avoiding duplication of effort and the focussed sharing of resources to potentially gain insight.

Engineering New Territories

It was interesting to listen how Powys became part of the partnership at a later stage. Especially as the inclusion of this authority would cause a large change in how the data was presented in any resulting maps displaying the territory.

"Now we've got Powys and Ceredigion it does add a significant extra dimension. Because previously rurality would have been North Carmarthenshire and North Pembrokeshire really what we were previously talking about, but now you do have two of the most rural, well probably two of the most rural counties of Wales. Obviously that's going to have a big impact in where the provision is, because I mean already Powys doesn't have a higher education institution, in Pembrokeshire we need to look at access to higher education provision from those counties, you know. Certainly with Powys, places like Newtown and Welshpool, we have to look cross border, who's going to England and doing what. That adds an extra dimension, because previously people would have still gone to a Welsh provision, so they still would have appeared in the statistics but in a different way, but whether that will cause much impact on certain things, that's worth considering". (Car5)

Note how the changing nature of collaboration within the partnership indirectly affects how problems are framed; the data collected and what is included in the map. In terms of representation, adding a large rural LA distorts the map in gestalt and reframes the collective definition of 'rural'. This suggests that organizational transitions stimulated by networks of actors can shape the choices of the mapmaker and ultimately what can be represented with the limitations of existing spatial boundaries. The changing configuration of organisations was associated with changes to mapping practices.

It was discovered that to some extent these joining of LAs were being engineered:

"...the addition of Powys to the partnership made absolute sense given that everyone was working together. The change in the landscape really was sort of forcing that partnership together". (SW1)

"It also mirrors the government association's collaboration map basically, which is basically, well it's six counties we work to, but it's also the, what is the SWAMWAC regional area, which is an education partnership, Welsh Government sort of supported. So we basically adapted a bit, added a bit of membership to cover the area that the Welsh Government sort of states we should be working with. So obviously it took a bit of time to get those partners engaged in that sense, and saying why, you know, had to sell it to them...the idea is that we will mirror what Welsh Government sort of want as collaboration region". (Car5)

Here it seems that the WG are setting the direction and - if you like - shuffling the LA cards. As a consequence, negotiations need to take place at a local level in terms of partnership working. The success or breakdown of these negotiations and direction can inadvertently affect what is portrayed within the observatory system. There are consequences, particularly when a LA such as Powys was included in the map. Powys was perceived to have benefitted from inclusion in the partnership

"I think they've seen they can get a lot more out of us than they have to put in if you see what I mean". (Car5)

The additional land mass affects existing boundaries in the map, making smaller areas even smaller; it refocuses and contextualizes the existing information. It seems mapping social and economic statistics in rural areas mirrors politics more than nature and nature more than people:

"It's just evolved over time to mirror, you know, what comes out of Welsh Government really". (Car5)

As a result, there were some parts of Wales that benefited in terms of their representation on the map more than others. It seems that partnership working and working across boundaries can cause issues in terms of mapping practice, particularly as new territories emerge. The point remains that while all this high level negotiation takes place the real issue in relation to mapping should be to develop a consistent household database of social and economic statistics to provide stability for mapping that could offer long term benefits. Collect at the most detailed level available and use many times (Rodgers et al. 2009). This would ultimately reduce duplication and provide a locus for coordination, raising awareness and map-based collaboration. This would require all those collecting data to be aware of what would be required to do so (e.g. what identifying spatial reference to collect, how to securely exchange information, etc.).

Evidencing Outcomes

An interesting example was provided in terms of piece of work that investigated the links between curriculum content at schools and the needs of the industry in the area.

"We've just purchased all this Cambridge econometrics forecasting data, and that matched with all the information that we held about the schools and the curriculum, it's like well okay, what is your curriculum, is that feeding the pipeline of talent, qualifications and skills that industry needs for the future? So we've been working with them on looking at that, and you know, bringing sort of the intelligence to the forefront, because it's not really traditionally how people plan the curriculum. It's been based on funding, what teachers they have there, how they've done it for years, what the demand is. But it's never really been looked at in terms of well what is the intelligence telling us, what skills are needed, what qualifications are needed to feed the industry we have here in the region". (SW1)

The statements, above, suggest a shift in culture in using evidence for policy making in Wales. The interviewee continued:

"We're nearly completed in that now, and there's quite a lot of debate and discussion around sort of rolling that report out across the regions really,

because curriculum planning, you know, the way government, you know, we listen obviously to policy and evidence coming through and you know, government in the future we know aren't going to fund things which aren't going to result in a job or a prospect for a job. So it's very much focussed on well we need to see the landscape now and in the future". (SW1)

This mirrors the sentiments of another interview conducted at the Beacon (see Appendix K) in terms of moving from an output approach to one principle-based on outcomes.

"If you're looking, rather than just having to get a qualification at the end of college, it is now qualification and a job, you're looking for that longer term picture". (Car1)

Therefore, there was a clear push towards evidence-based working, based on the joint effort of several organisations, according to the agenda of the WG.

The WG also influenced the need to collect this type of evidence in the first instance but also influenced the type of data collected:

"We're just completing a report on apprenticeships because obviously that's very topical at the moment, a lot of information's coming out of government in terms of the importance of apprenticeships going forward. So we wanted to look at well what does the region offer at the moment, what is out there, what are the gaps?" (SW1)

Therefore it appears that the InfoBase Systems have a dual role in promoting a certain style of evidence-based policy making but also providing the evidence within this framework. They set the rules and provide the resources but at the same time work within conditions imposed by the WG.

Reflecting on the discussion with the RLP, it is clear that they perceive their role to be supporting policy decision makers who are less familiar with social and economic statistics. This involved reusing data currently available in tables, extracting the key messages then making this information visual. The following interviewee noted difficulty in using WG data:

"I mean a StatsWales table is a StatsWales table, it's not easy to find, it's not a very good way of finding information". (Car5)

It was clear that although the statisticians within the WG perceived StatsWales as a useful resource this opinion was not universally reflected:

"We talk to so many people who are, they're terrified of data, they need it in their everyday job, they're asking, they're being asked to use it more and more in terms of their decision making, but they're terrified of it, they don't know what to do with it. You give them all this information but they don't know what to do with it. And they need to be able to visually see it in a way, which is more manageable for them to digest and understand and present. And I think that's the biggest challenge for the people at the moment, is how they digest and present that data". (SW1)

This situation is set to worsen in an era of 'big data'. The problem identified here was that if so many people were terrified of the tables of data, they may well choose to ignore the information altogether unless it was brought to their attention in a comprehendible format.

"But what we are looking to do going forward with the RLPs as well, is do more of a bespoke analysis type service. So whereas at the minute we basically collect, er, data from different places and bring it into that. So anyone can just go and view it themselves, we might be putting a bit more a, a bit more a spin on how we present that data...looking at the how you visualize it to get, get the impact. Because, um, as much as it is quite good just to, to view the basic statistics as they are, you know, down to areas where, and things like that. We need to start bringing in something, imaging things, so you have an impact really, do you know what I mean?...because, I mean, some of the stuff, particularly, er, linking back to the original sort of stuff I did with the hub stuff, um, you know, it very much got, caught people's attention because it was visual, and it was in... And then people could go down from there then... So they would see, see the map and, you know, they can relate to that... You know, it's because a lot of the time, with some of the statistics, particularly around things like GVA and the employment stats, they are, they are very big numbers...and they are very distant... So, you know, you have got unemployment in Carmarthenshire, say, at eight per, eight per cent, it doesn't really feel relevant to, to you. Or the, the wider environment, do you know what I mean? So that's one thing we want to be looking at in the future". (Car5)

But this shifts the responsibility of communication to those interpreting the data on their behalf, to provide the main points and not the detail. Without audience 'buy in' these tools may well still go unused, as noted by Campbell (1996) success can sometimes rest on key users feeling that they contribute towards the development of these systems.

It may be useful therefore to stake stock of those vested in mapping social and economic statistics and develop a compendium of their specialties. Each person may have certain a certain body of knowledge they can contribute to the mapping process.

There was a perception that some LAs were still confused about how to deal with statistical units such as LSOA:

"One of the sort of complications is, particularly with local authorities is when you're talking to local authorities they talk wards or LSOAs. So your LSOAs don't match your ward areas and your ward areas don't match your LSOAs. So when someone says what's it like in Llangollen ward, well okay you might have some data, and were we've got it down to ward we do have it in ward, so we have it in ward and LSOA depending on which one is more relevant to you. I mean obviously LSOAs are better in the sense that they're more closed units but wards are what people talk about in LA environments, do you know what I mean? That's what councillors care about, because they don't get elected to LSOAs, they get elected to a ward and they want to know their ward, what's happening there.

So that's one of the biggest sort of problems, is you know, what data fits what people and you know, whether people recognise it particularly when you've got LSOAs and things, do they get a feel for where that actually physically is? Because if you look at Llanelli or something like that, someone might request and say can we have, you know, unemployment statistics for Llanelli, does that include Llanelli town centre, does that include Llanelli rural area, does that include up towards Cross Hands, where does Llanelli start and where does Llanelli finish? When you map it then it would be up to them, because when we obviously choose it on there it will have all the ward areas anyway, so you know, people can pick and choose which ones they want and classify it their own way. It is an issue in terms of determining spatial areas, that people can relate to the learning statistical units really". (Car5)

This clearly adds a degree of complexity to the process of data sharing and linking. It appears that the more people the data passes through, the more interpretation and assumptions are bestowed upon it, as information travels further from its source. As rural statistics become encapsulated in spatial boundaries and then mapped and shared within digital networks hidden issues are lost. It highlights that there is a problem when social and economic statistics are shared using choropleth maps over the Internet, especially when they are detached from their local contexts. Interviewees highlighted the importance of inserting frames of reference within the map.

"Well it is really good at getting the impact, because you can automatically see the, the township areas...straight automatically, without even having the base mapping on...use all the visual, oh that's, that's Carmarthen. And so, and that's Ammonford so, you know, you can see, and you, sort of, know in your mind where these places are. So it's...it's, but you have got to prove that to someone...further away who doesn't know these areas necessarily, so you have got to...like go back to the, sort of, the hub stuff, and I know what Llandovery looks like, I know, kind of, where things are in it, but someone from, you know, er, WEFO, or maybe...if they had to go somewhere else again, they wouldn't have a clue really about Llandovery, what's in it..." (Car5)

However these frames of reference were also only useful as navigation tool within the context of map and still relied on knowledge of the places depicted. They could guide within the map space but said less about the place.

These comments were interesting to listen to because they suggested that mapping practices were being used almost as a mechanism for enrolling political support from a wider audience. The relationships formed between the map producer and the map user appears to play an important role in the outcomes of map-based decisions. This is particularly the case if the audience perceives the statistical map as an objective and mimetic (November et al. 2010) portrayal of social and economic conditions. They would then be open to persuasion.

Changing Barriers to Providing Rural Statistics?

The main issues and barriers when attempting to represent rural statistics were discussed during the interview. These fell into several categories: data sharing; accessing small area data; knowledge transfer and engaging audiences.

In terms of accessing data to disseminate, it was noted that some organisations were more cooperative than others. When discussing the links with LSBs:

"We do work with the LSBs, we do have a close link with the LSB network". (SW1)

When asked about how data was shared with LSBs, the interviewee explained how the RLP led from the front in terms of sharing data but that sometimes the flow of data was not reciprocated:

"The whole point is that we all share...it's frustrating when there isn't, when there isn't that coming back but generally the partnership is all about sharing that data and that intelligence and working very, because you know, there's a lot of single integrated plans being developed by the local authorities at the moment, which we're all working close with the LSBs, working closely with ourselves now in terms of feeding into those single plans". (SW1)

It was interesting to hear how data sharing practices often hinged on personal relationships rather than formal procedures:

"Yeah we have, we sometimes have a good relationship and share information, sometimes we don't, and it can vary depending on who you ask in what organizations" (Car5)... "It isn't a straightforward smooth all open doors process, it's not quite like that yet". (SW1)

The interviewees also explained some of the barriers towards sharing data for small areas and how it revolved around the cost of purchasing licenses, issues of disclosure.

"And that's when it becomes, it becomes a lot more complex in terms of that I can't just, for example I'd have the data in front of me and I can't just hand it over to you. So then there's a timeframe which the needs assessment plan is complimentary to what (SW1) already said, and it's the integrated, the single integrated plan which is, I know currently they're due to be turning that over in summer. So they want this information on quite a timely, and that's when it becomes a lot more complicated. So as you can see the

channel of passing information over, because of sharing protocols, is a challenging". (SW2)

There are several issues within this passage that affect the representation of rural statistics. As small area data needed to be aggregated it made it even less representative of the people living in rural areas and masked important differences between neighborhoods. It was suggested that this may not be given enough attention because of a disjoint between project deadlines and the cycle of data release. This presents another juncture where rural statistics are at risk of being misrepresented.

An interviewee stated:

"One of the difficult things is there's not really a standard template out there for it. I mean there is the Wales Accord on the sharing of personal information. But I mean that's very detailed in the template that it is, and it's for literally named persons and persons protected characteristics, we'd only be getting anonymous information, we'd have that stripped out before we got it". (Car5)

This made the data less useful for joining to other administrative records held by the organisation. This is an area that clearly needs to be given further consideration in the future particularly if the WG is encouraging collaborations and partnerships.

Another example was given with regards to small area data access negotiations - this time with the WG. The interview indicates how long the process takes:

"That's one thing I've come across, we started looking at trying to get information directly back from the Welsh Government regarding the lifelong learning Wales record, which basically covers further education learning and basically any post 16 learning activity that's not higher education, if you see what I mean". (Car5)

The interviewee explained how they are attempting to join up data at the individual level.

"The main thing that gets in the way is they've got to have formal data sharing protocol written up. So we've got to say if you were to give us your data what exactly we'd do with it. So you know, we've got to say how, if we were to aggregate it we'd have to do a, take your own personal information,

or if we were to map it in that sense how we go, what processes would we do to ensure that we don't go and disclose personal information. And that we have a robust enough computer system here that, you know, fairly fortunate because we've got Carmarthenshire's IT system which is quite well regarded in terms of security. But at the same time we can't just be taking it around LSBs and just giving it to whoever". (Car5)

The interviewee added:

"I mean we've only started trying to get that information in the past month or so, and they've been fairly good with us so far in terms of we've come back, they've come back to us with more detailed questions and we've come back to them. And they seem fairly enthusiastic, they like the sound of the things we've asked...and so this is quite interesting you if get hold of that data. When we started, um, going back and forward to get some data sharing agreements sorted out to get us a...at the minute, we basically are trying to get an extract of the LLLW record, which is the Lifelong Learning Wales record". (Car5)

It is clear that some of the formalities in data sharing were yet to be overcome. As the process was not straightforward, it became time-consuming. Moreover, it must be difficult to know exactly how useful the information will be until it has been accessed. There was then a general barrier in terms of limited awareness of the level of detail required to share information for explorative purposes.

The sharing of information was not only an issue between the RLP and the WG, it was also apparent between LAs. The interviewees, below, explained this:

"That's more open, but I don't know, there's been challenges about yes we can get data, it comes in all different shapes and forms and formats and that's the biggest issue. And then that's a challenge for us, because it comes in differently from everybody. So you know, trying to get like for like data, that's been a challenge". (SW1)

This must partly be associated with the historical legacy inherited from past political order and alignment:

"Yeah, different people fill out different forms, have the same information in different ways, so it's, sometimes less work for them if we just ask can we have this, but at the same time it comes back to us in ways that don't match,

and we've got to try and get them to fit each other. You know, we build our Excel sheets depending on whatever's what. But what happens sometimes then is you go back to them and they go oh that's not what we sent you, because it's in a different format and because it looks different they've gone oh that's, so they've said oh that's not right". (Car5)

It appeared clear that a new era of policy making and planning was forming in principle but practice was slow to respond, mainly looking to technology to resolve what appear to be issues aside from these systems.

"This is a bit of a gap, in that there's the will and the want but the formalities to actually bring that together are what's holding it back really, yeah". (SW1)

"Yeah, because technically we can do so much more with the information that's out there. It's just literally getting the right people to know the potential of the data they hold, and getting them to release it in a certain way, there's an argument for that". (Car5)

It was clear that the Data Unit wanted these InfoBase systems to influence mapping practices in Wales. During the interviews all paths appeared to head back to the DU. To explore how these InfoBase systems had developed during the study a return visit was made to the DU several years after the research began.

6.4.4 Back to the Future? - A Return to the Data Unit

The visit was made to the DU offices again in 2012. The purpose of the return visit was to determine how the role of the DU had changed and along with the concept of InfoBase as a support tool for local government. The interviewees reflected on what they perceived to be the practical problem they resolved:

"Our remit then was to make what was massively available to everybody more available, more accessible because we realized that obviously researchers in Local Authority were struggling ... to just get hold of the data to be able to do the proper analytical work and make intelligence out of it" (DU4).

The interviewees reminisced:

"[DU1] was the champion of it, [he/she] was the selling force of the InfoBase systems in their infancy". (DU4)

However, it became clear during the interview their role now, instead of marketing the product, had become much more about enrolling interest in these systems. There had also been some change in staff and their roles. Rather than procuring and managing the software, the focus was now was getting people to interact with the systems. These systems were deemed necessary to provide evidence for strategies and plans. Now key actors at the DU assumed roles associated with dissemination to ensure this was done consistently and to appropriate statistical standards.

The DU explained that their software had gone through several updates since the first meeting:

"We've gone through version five to version six and then we've just gone through semi-major releases then, so one, two, three, four". (DU5)

The software company, GeoWise, provided these updates. The interviewees mentioned how the company planned to move the platform to HTML5 in order to function on mobile devices that were not compatible with Adobe Flash, e.g. I Pads. This meant that the software could function on more mediums and interestingly meant that the interface became more mobile, meaning they could be used on-the-go if required and could be linked to GPS positioning. Despite these updates, the core functions had remained the same. However, the interviewees explained that the software company was continually releasing add-on modules that could be used to display the data held in different ways if required. The DU had not chosen to adopt many of these as they felt it would over complicate the interface for theirs users and were not at a stage where they could begin testing.

"And we've got a really, you know as the Administrator of who, what the user sees, make sure that that is the best presentation or dissemination". (DU5)

This was interesting as it highlighted how the DU had established an influencing role in how information was presented to local government. It also demonstrated how the software company was able to align interests within the local actor-network from a distance. However the social and economic interests of local governments need not necessarily be aligned with the datasets held by the Data Unit or Software Company whose software controlled the horizons within which the information was represented.

The interviewees did mention that they had attempted a technique that displayed two maps next to each other (to show differences between years or data types):

"One of the things we want to do then is try and enhance some of the mapping type functions that we do in there, so double maps etcetera, do a bit more so that we can help them analyse their data better, so there are things that we're moving slowly towards improving functionality". (DU4)

This was an interesting development as it suggested that alternative ways of representing rural statistics (e.g. cartograms) could be shown alongside choropleth maps. This is useful as it keeps familiarity but offers a device for others to learn.

"something I am a bit weary of is if we were to use them that people would not fully understand them. For example you know elected members they like to see data based on their electoral wards". (G1)

"I think they would be difficult simply because people are not used to them, so if you are doing analysis and research I quite like them because to me they bring out some key points...but trying to explain what that is showing and how to read it to someone who is not used to dealing with data is something I would find quite difficult". (Conwy)

The InfoBase system had largely remained constant in terms of its content and function; its role in practice, however, had taken a new direction. The major change was that there was no longer a focus on the LA model for local systems and this had instead become a focus on LSBs and their needs for producing single integrated plans. The local systems were now functioning as LSBi (where the 'i' stands for 'insight').

"It's interesting, you know as we designed, erm, Info Based Cymru back in 2009, 10, erm, this idea about having these Local Information Systems which were Local Authority boundaries was very much that they were supposed to be telling their public about data that was available, so it was that sort of system. What's changed now is this Local Service Board thing, so we're no longer thinking that we need to create Local Authority systems but these LSB systems...which actually are very similar board, there's nothing really different but the slant and the focus feels really different for

them out there. So we're still creating, erm, smaller systems than the national system if people want us to but not on a free process. So the free ones are the big nationals that break them down by the little bits...and if people want to do different stuff at local level then they're probably doing it more on a Service Board idea now than they were the old systems like Bridgend⁵⁴". (DU4)

The LSBi systems were now aligned to the interests of LSBs who had formed because of ongoing plans of the WG. As a result, many of the early InfoBase projects that had established either as pilots or as LA support tools had ceased.

"We've had demise of a couple of the local systems but it's for the reasons that we think around a political agenda..." (DU4)

The two major reasons were that either there was staff available that could provide a similar service in-house (e.g. Powys) or that the resources were not available to continue (e.g. Caerphilly, Conwy):

"They had to cut significant funding internally...including, er, redundancies, so they didn't feel that they could support" (DU5)... "Keep a system without people". (DU4)

It was noted that as the LSB model was now established:

"Some people sort of realised they were going down a route that was wrong, it was going to be too Local Authority based and not the Service Board based." (DU4)

A consequence of the LSB model was that new territories needed to be negotiated:

⁵⁴ A follow up interview had been conducted with Bridgend. The local authority was struggling with its statistical mapping function due to decrease in staff (e.g. original interviewees were no longer at the local authority). They outlined how they planned to adopt an LSB approach to data sharing. The new LSB had created bespoke neighbourhood network areas for which they were planning to collect data. It was noted that these areas were not coincident with existing rural boundaries (according to the RDP, 2007-2013). These may have consequences for how the LA represents rural data.

"Obviously you've got Police and Fire and Health and they've got different borders haven't they and Police will cover several Local Authorities". (DU4)

"What we have done though obviously Info Base, er, primarily looks at geographies at Local Authority level, Wales and LSOA Data...but with LSB Insight we're kind of tailoring that, er, that dissemination to, er, local health boundaries...er, Fire, Police and Local Authority, well that's the plan so. Yeah, to much more reflect those partner boundaries". (DU5)

Also the data that was collected was done so according to themes that fit within the WG's Programme. Therefore, the LSBi systems were tailored to these local needs.

"Load once really, you're not doing it the six or seven times for the systems that we might have, so it doesn't, the amount of systems doesn't necessarily mean large amounts of volume for us...it's stored once, used many times ... so it's from the central database and it'll have well five, six, seven, erm, front ends". (DU4)

As such, the WG was directing the role of the DU as the intermediary, setting the context in which decisions were made and the type of data required to make these local decisions. As a consequence, the boundaries for representing rural statistics were constantly being re-contextualized - despite being housed within the same spatial units.

Another interesting point noted was how the reduction in public sector funding in Wales had created redundancies but this had accelerated collaborative activity and made strategic evidence more important:

"So the emphasis on evidence and research has actually become greater even though they've not replaced some research posts and they're not, certainly not increasing those but the need to have clear evidence for everything now is stronger than ever which is brilliant for InfoBase and InfoBase Systems..." (DU4)

Although it was noted that different LAs were perceived to have different research cultures.

"There's still Authorities, not by their own fault but they were, just never were set up for good research, so we were speaking yesterday to an event to Merthyr who know that because they're small that they've never had a strong research function, they lost their one researcher during that time due to retirement, they've never replaced [Mer1] there, erm, and they all know now that they're struggling. They can't invest in having the right amount of research support and evidence bases and they realise that they're falling behind the rest of the Authorities...but you know that's why we provide then InfoBaseCymru which I think they can rely on and LSB Insight at the national level to just be able to look at the bare minimum for Merthyr". (DU4)

This was an interesting quote because it insinuated that a lack of quantitative data for a LA was causing it to fall behind other LAs. So what then if population-sparse areas have inappropriate evidence? Does this mean that rural areas fall behind their urban counterparts?

Standardizing Boundaries and Rural Places

It was interesting to discuss the suitability of spatial boundaries with the DU for representing rural statistics particularly as they felt the role was to just select and mediate the GI and not to manipulate it.

"So initially when there were, erm, you know the sort of Local Authority based ones, they very much worked on the Ward basis didn't they and there were one or two that insisted on having Ward level data in there, we would shy away from it statistically because of its difficult to show comparison over time but we appreciate...our standpoint is that we believe that LSOA gives people a more robust base to look at comparison over time and comparability within areas, so across areas, so you know that LSOA is the same sort of size as that LSOA, when you look at Wards you can't do that, erm, but we appreciate that people have to report on Ward because that's how their Councillors want it, however, we would still keep pushing for Councillors should be able to work within Ward boundaries but be able to use the LSOA within it to see variation". (DU4)

"And looking at deprivation data is a perfect example of why we would push that because obviously, erm, the LSOA will actually look at...you know pockets of deprivation within a Ward...which you know makes sense". (DU5)

"So Vale is a really good example because you've got, erm, bits of affluence not so far away from you know really poor areas of Barry or whatever and you need to be able to really differentiate across the areas what's going on there. The, erm, well I mean both of us are the geography based people". (DU4)

These were interesting quotes because it suggested that the boundaries were framing the problem. In this way, deprivation was only known through LSOA concentrations, despite existing for many outside these frames of reference.

The interviewees explained the policy for using LSOA boundaries and aggregations of these areas (MSOA, USOA) particularly for reporting health statistics. When questioned as to whether these were the correct units for representing rural statistics the interviewee explained:

"They still give you a population base which is really useful, a population consistent base so you get your fifteen hundred or whatever it is and you can then say you know in this one it's much more rural, you can see that your fifteen hundred are geographically more spread, so you can use density to support that can't you but you know within that fifteen hundred people then you can you compare characteristics, so male, female or something more complicated. Erm, if you move to Wards and LAs then you lose all of that, so that's why I'm dismissing the non-statistical geographies. If you're asking whether LSOA is the right level, I don't know". (DU4)

The DU releases data according to the ONS urban-rural classification but does not aggregate its datasets to any other rural classification. This was a potential area that could be developed to assist LAs plan for rural development funding in the future.

The interviewee also outlined how they had produced guidance on how to represent statistics within maps but acknowledged that much of this was out-of-date and concentrated on presenting basic maps using desktop GIS. There was no official guidance produced on best practice for representing population rural statistics by the DU.

Despite this, the DU worked on specific projects that require this guidance.

"Rural Housing Enablers around their, they have to do, erm, work to look at where they should put affordable housing in particularly rural areas, so there are a selection of those across Wales, erm, obviously based in the rural areas and we've done a lot of work with them because of the survey work that they have to do to understand whether the community a) requires b) wants affordable housing to go in certain areas, so that's a sort of route in for them but, erm, some of that obviously links into the sort of rural statistics". (DU4)

The DU noted difficulties mapping this and other types of survey data (e.g. Welsh Health Survey) within the InfoBase systems and the requirement to aggregate to larger spatial boundaries. This suggests that mapping is dependent on small area statistics and these statistics are dependent on obtaining sufficient respondents from surveys. If rural statistics issues become hidden using larger boundaries then their representation also hinges on the availability of small area statistics such as the census. Small area statistics ultimately requires some sort of funding to be collected. With dwindling public resources even the census small area statistics may not be available in the future. This means that InfoBase systems and rural statistics are aligned towards the same goals and both include some form of mapping.

The Future and the Census

In terms of the near future, the DU perceived further work refining the dissemination of data for the LSBs Single integrated plans and automating parts of the process using APIs. Therefore they are moving to a distributed GIS architecture and not actually having to store data locally. The INSPIRE directive was discussed and it was clear that this was not a priority in terms of the InfoBase systems but the DU would have a wider role to play in terms of providing advice. Interviewees indicated there was potential to disseminate some environmental data housed by other organizations within the LSBi systems.

In addition, the interviewee suggested that the DU would have an increasing role to play, as there would be an ever-increasing amount of data and requirement for this data to be assessed and interpreted so that it can be used for local government. They also indicated that there was an increasing need for data to be made available at a granular level, the lower the better, but questioned how it should be used

because it becomes less robust. They also highlighted how granular data can be compared between local areas and with elsewhere in the UK. There was also concern that the census may not go ahead in the future and in response the DU positioned itself as an advocate in the Beyond Census 2011 talks.

"Beyond 2011, I don't know how much you know about their ideas at the moment so they've got all these different ways that they could collect this type of data and they're asking to understand what is it that you need, so the high level I need population, that's easy to argue isn't it, they definitely need that at local authority level and they're pretty much okay that they probably need that at erm, LSOA level but they produce it at output area level.

Do people need it? They're not sure; they haven't justified any real uses of output area level. And yesterday was focussing particularly on what is the use of small area data and how...how much of it should be collected. And there were a few, only whether it'll be enough of a few, people who use output area then to build bespoke geographies that are not necessarily LSOA based or...so somebody yesterday was talking about, you know, within three miles of a swimming pool and they'll use er, output areas to do that whereas you might've used GIS and other different technologies there. But, you know, output areas could be used to look at that. So there's something around the small area stuff, and it's the attribute data rather than the population count that's really important isn't it?" (DU5)

However, data at the individual or household level would not necessarily need to be used in a similar way to how it is currently presented, particularly if it can be linked with other administrative datasets. Take for example the work currently being developed at the SAIL databank. This highlights a future research topic. How can this linked data be used to explore issues in population-sparse areas? How can this information then be represented spatially without identifying individuals? What is clear is that there is need to detach rural statistics from their boundaries to better understand rural issues.

The DU deemed the census statistics for Wales to be important for Wales as it provided the benchmark to recalibrate many government tools.

"It's important data, to see it visually is the same as every other data set, but because you're working probably at LSOA level, then you have to be able to see that. Because I don't think LSOA works as a table". (DU4)

The DU disseminated census data released by the ONS. However, due to capacity issues, they needed to pick what datasets they deemed most important.

"We were communicating a slightly different timetable but you know some people were happy to wait for census data because you know it's going to be easier than trying to get it through the ONS..." (DU4)

A problem encountered was that some of the stable units such as LSOA had changed between census periods causing confusion and the need to house two versions of LSOA boundaries for 2001 and 2011; possibly highlighting why services such as the DU exist in the first instance. The DU notice a peak in website hits when this information is released - indicating its usefulness.

Possibly because the InfoBase Systems of the DU and the census are interconnected, the DU plays an important role in raising awareness of this type of data and actively promotes its use. In addition to its advocacy role, it uses social media channels to raise awareness. Essentially, enrolling the widest set of interests in this data and highlighting that InfoBase systems are the obligatory point of passage for accessing it. In this way, the ONS acts at a distance.

6.4.5 Summary

The DU appears to be fulfilling a role created by existing barriers; at present this role appears to still be communicative in nature. Perhaps however in the future the DU could do much more. It clearly is best place to coordinate local level action and align practices according to national priorities. In this sense then it is best if the representation of rural statistics be coordinated through this node. The platform is already being created for diffused mapping; perhaps next geocollaborative environment can be created for explorative rural mapping. This would require building bridges between SAIL, the ADRN, and the DU to ensure a coordinated effort going forward. This could act as national learning network GI theory and practice and a place where research could help incorporate other ways of knowing places (e.g. qualitative GIS).

Chapter Summary

This section has presented the findings and analysed the evidence accumulated from several stages of interviews and observations. It has interlinked several sources of data including existing policy documentation.

The first section has helped explain common practices for representing rural statistics in Wales. It was found that limited staff and resources meant that geovisualization was often limited to basic choropleth mapping and overlay. In this sense the mapping capacity in Wales for core policymaking organisations was small and even smaller in terms of those working with social and economic statistics. Rural mapping practices were limited locally by a lack of detailed geographic social and economic data. A multitude of data existed but often could not be utilized below the LA level. Training in handling GI appeared limited with much learning-taking place through experience rather than through formal mechanisms. With evidence of best practice found sporadically in uncoordinated and often hidden activity and often as reaction to the barriers imposed. Data linking for rural statistics was further complicated by changing and modifiable definitions of 'rural' Wales. Boundaries could be changed for pragmatic purposes but have further consequences for coordination at a local level. Fuzzy definition may well be appropriate but can result in confusion and duplication of effort. It was also found that perspective from which mapping was approached played a large role on what was considered a priority within the maps frame. There were clear differences between WG and LAs particularly in terms of how they deal with population sparse areas. The WG showed evidence of private explorative mapping activity in rural Wales but this was rare within LAs who tended to use maps as a rhetorical tool to display need or market their priorities.

The next section explored how mapping practices could vary within one LA demonstrating how maps were be used to explore and to communicate both being dependent on experience and training. Despite working with similar data there was a great deal of variety in perspective in terms of how even the same data should be presented.

The third section has demonstrated how the DU has a key role in coordinating activity and providing services for LAs struggling with evidencing need. It seems that

this is where the future of mapping in Wales is heading but at present there is limited consideration of rural representation within InfoBase. However it does offer grounding for future geocollaborative practices and incorporation geovisualization ways of representing places e.g. double mapping and cartograms.

7.1 Introduction

This chapter presents the conclusions of the research. The meeting of the research aims and objectives is outlined in detail showing the conclusions from the research. The contribution to knowledge made by this research is presented and areas for future research identified.

What better way to begin than by reflecting on a quote from when the uses of digital maps for the social sciences were in their infancy over twenty years ago?

"Social science does need maps; but the maps that are currently drawn in its name, apart from often being bad examples of physical geography's cartography, are bad social science. They make concentrations appear where they are not, and dissolve existing patterns. They rarely portray anything but the most simple of spatial distributions, certainly not spacetime evolution, or the interrelation of a dozen different influences."

(Dorling, 1991)

This quote was just after the release of the Chorley Report (in 1987), which ushered computer mediated maps, geospatial technology and digital GI into the domain of the UK government. Since then the role of government has changed and GIS technology has become diffused within policy-making organisations. Meanwhile, the fields of geospatial technologies and GISciences had also evolved as disciplines. This thesis explored the juncture of these disciplines to uncover how changing practices affect the representation of rural Wales.

Reflecting on the quote above and the findings of this research, it now appears that policy making does need maps but many of the maps drawn from social and economic statistics, apart from often being bad examples of physical geography's cartography, are bad social science. By focussing on the communication of statistics rather than exploration, they make concentrations appear where they are not, and dissolve existing patterns. By focussing on simple spatial distributions, they can be used to promote certain rural issues but, in doing so, cause others to remain hidden

from view. In rural areas, it is difficult to show change over time using maps and it is difficult to obtain data on different influences - let alone show their interrelation.

The original focus of this thesis was the scientific visualization of rural statistics for policy making in Wales. While working at the WRO, it became apparent that some of the methods used for representing rural statistics in policy making could cause rural social and economic issues to be hidden or misrepresented in maps. Mapping, at the same time, could highlight issues and summarise a multitude of spatial information within a single representation making it a powerful tool. It could also be used as a rhetorical tool for communication and for coordination.

Statistical maps were becoming increasingly used elsewhere in policy making. This thesis sought to explore how rural statistics were utilized and understood in mapping practices. In doing so, the research intended to uncover the factors that made their representation for policy making problematic. Initially, these factors were thought to be a technical issue alone. In fact, the topic of this thesis arose from what was initially perceived to be a human-computer communication problem that required a technical solution. The two main technical issues were initially found to be the MAUP and the Ecological Fallacy. However, the further the research delved into the literature; the working environments and the experiences of those involved in representing rural statistics, the more it revealed that technical problems were but one of a myriad of human-centric issues. These issues ultimately became reflected in the activities and mapping practices for policy making and the function of the resulting representations of rural social and economic statistics. This manifested in a certain type of mapping culture for policy making; focussed on communication rather than exploration. Herein lay the problem; for policy making, the focus was on communication but to reveal rural issues requires exploration.

7.2 Responding to the Research Questions

Using a qualitative approach and mainly utilizing in-depth interviews, the study aimed to move closer to responding to the research questions of this thesis.

- What are the benefits and limitations of scientific visualization for policy making?
 - What factors limit the scientific visualization of rural statistics for policy making and how could this be improved?

- What has happened in Wales since the Chorley Report with regard to the use of GI and geospatial technology?
 - How does this affect the ways in which rural statistics are produced, understood, stored and communicated and contested?
 - o How reliant is mapping on technical and social factors?
- How are maps currently used to represent rural statistics for policy making and planning?
 - o Why is mapping used?
 - o How does this vary between and within organizations?
- How are the current dynamics of mapping changing in Wales?
 - What role do data custodians now play in mapping rural statistics in Wales?
 - How can mapping affect communication and decision making within collaborative environments?

The empirical findings within this research revealed several interesting points that had consequences for how rural statistics were portrayed.

As the policy making discipline had adopted the practices of cartography, social sciences, statistics, GIScience and IT, so too did the conceptual lens of this research. This meant that issues needed to be explored within juxtaposition of academic literature but also by using policy documents, artifacts, and interpretations of those closest to these mapping practices. This thesis has outlined how many of the difficulties in representing social and economic statistics for policy making were caused by complex interrelationships between technology, people and institutions. Moreover, it highlighted that there was a subtle interplay of these relationships at different levels of organisation.

Within each organisation both national and local barriers to mapping practices were encountered. Many of the national barriers were similar in topic (policies, funding, OS maps, GI collections, administrative boundaries, legislation) but different in terms of the local implications. It was within organisations where the local interactions of people, rules and resources and the confines of technology encountered the final agency of mapping. In practice, this was where local mapping took place.

Each organisation, despite containing similarities, was unique as a collective in their approach to the mapping of rural statistics. The WG presents the national picture while LAs and their partners present the local detail. Moreover, within most organisations, the final responsibility for mapping social and economic statistics often rested with one or two individuals. It was these few individuals that attempted to translate policy issues in to policy facts and related actions. It became obvious during this research that any universal attempt for improving the representation of rural statistics would have different local consequences. Hence, national datasets and standards increasingly became problematic the more locally they were applied. This suggested that mapping perspectives differed between organisations, organisations that were aligned to the geographic boundaries for which data was collected and presented. Different perspectives could be more or less advantageous for different organisations; for example, nationally rural areas often dominated the map due their size - locally the size of the units could mask the detail required to assess local needs.

Many of the technical and human barriers had been realised since the inception of GIS for government purposes. The Chorley Report highlighted several areas of concern that could hinder the use of geospatial technologies for government. These were digital topographic mapping; the availability of data; linking data; awareness; education and training; research and development; the role of government and the machinery for coordination. Progress in each of these areas has been made, but all at different rates and each to a different extent. Moreover, as progress was made in these areas, the cartographic discipline was also changing, as was the style and structure of government in the UK. This meant that progress in general within many of these themes did not necessarily entail progress in the ability to visually represent rural social and economic statistics for policy making in Wales. The barriers have become warped.

Technological change was mainly driven from developments in other countries that had a different policy towards GI than the UK. The result of these rapid technologically driven changes is a wealth of literature on technical issues related to geospatial technology and a wealth of literature on planning and policy. However, both literatures were becoming increasingly detached from current practices. In addition, limited attempts had been made to weave both literatures together within one conceptual framework.

Exploring the theoretical foundations of cartographic and planning practices revealed many fundamental weaknesses in the disciplines that exposed both mapping and planning as sites for critique. These critiques persisted as maps became digital within geospatial technologies and planning took a communicative turn.

The persistence of the drive of technology appears to overpower these critiques and resulted in the current ubiquity of mapping practices in all their forms. In addition, despite the increasing importance of collaboration and evidence in policy making, it still remains that few can change the scientific orthodoxy of current mapping practices. The common practices of using maps in policy making and planning often concealing fundamental problems, resulting in important issues being sidelined from the political agenda or ignored. As a result the ways in which maps were being used in policy making had social and economic consequences and not least for rural Wales.

Previous studies (see Section 3.3) had tracked the diffusion of GIS as it came to be used within LAs and government organisations. Several of these studies highlighted the importance of the managerial approach as well as social interactions and organizational culture. Despite documenting important evidence of the spread of geospatial technology, limited attention was given to the context and intricacies of how people in practice attempted to use maps to explore spatial problems. This thesis therefore aimed to build on this previous work by offering a sensitizing device for moving closer to the types of issues faced by those interacting within these contexts on a daily basis. The critical issues that shape the differences in mapping for policy making.

This research aimed to square the circle by adopting a qualitative approach to studying what has come to be a mainly quantitative practice: the practice of statistical mapping in policy making. Resting within the social constructivist paradigm and adopting an interpretive lens has helped the study move closer to the critical processes and operations of these mapping processes.

7.3 Reflection on the Chorley Report

This thesis was able to explore from a participants' perspective how the barriers outlined in the Chorley Report had been tackled and what the consequences were in terms of the representation of rural statistics.

Much has now changed in terms of GI and geospatial technology in general and in Wales. At the time of the Chorley Report in 1987, the use of geospatial technologies was low for dealing with spatial problems in the public sector. However, there was growing evidence of its potential in many areas. Outside of the UK, North America took the lead and started using GIS to conduct the US Census of the Population. Moreover, the technology and data had commercial value and was being used for marketing and business location.

The Chorley Report, in its advocacy for the use of GI and geospatial technology, outlined barriers that could hinder widespread adoption, mainly within the public sector. These barriers have been discussed throughout this thesis and will now be discussed in terms of progress and the consequences for the representation of rural statistics.

7.3.1 Barrier: Government as a Mechanism for Coordination

Aside from its involvement with the OS, the publication of the Chorley Report was the first significant intervention by the government in terms of the GI and Geospatial technology industries.

During the research, the e-gov agenda was beginning to affect practice. As part of this agenda, a secure network for exchanging information had matured and included architecture for sharing restricted or sensitive social and economic information. Although not in direct response to the requirement for GI, these policies had an indirect affect on mapping practices. As part of these policies, there was now also a clear emphasis on how citizens could become part of the wider decision making processes. The government's role would be to facilitate and provide the machinery for these interactions.

At the same time, European directives were ensuring consistency in the collection of (mainly) environmental datasets and boundaries across EU countries. The implementation of the INSPIRE directive encouraged the need for the development of a location strategy for the UK. Location Wales sets out how the existing strategies developed by the UK and in Wales should be delivered.

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The environmental focus on GI emanating from EU directives appears to prioritise a land dominated conception of space. This could have potential consequences in terms of how rural statistics are framed within geospatial technologies in the future.

In addition, a desire to adhere to INSPIRE directives can push social and economic priorities further down the list of issues that need to be resolved within organisations. Consequently, the need to develop appropriate strategies for displaying rural statistics may become overlooked and continue as usual.

Platforms and infrastructures appear to be in place for sharing the restricted social and economic data that could be used in explorative mapping practices that enable the data to be explored at the household level. This would help to remove some of the statistical issues with representing rural data using the existing geographical boundaries.

It remains the case that much of the solution still rests with the culture and practices of people working in organisations in Wales. During the interviews, it was clear that many had not developed strategies to deal with the top down directives. There appeared to be mixed awareness in terms of the importance of these initiatives. For example, many still reported to have informal procedures for sharing information. There also appeared to be little coordination in terms of handling social and economic statistics other than the adoption of LSOA as a standard geography. The building blocks for representing social and economic statistics were becoming normalized within much broader directives aimed at standardization. They could have the consequence of further locking social and economic statistics to certain rigid geographic boundaries.

Hence there is the need for clear coordination at a local level within Wales. Groups of LAs and their partners could work together to raise awareness of the need to collect detailed GI that can be shared regardless of boundaries. Good practice could then be developed, e.g. attaching an UPRN to all data collected. There currently appears to be a void in this area and incentives to act, and knowledge of the resulting benefits are not being affectively communicated.

A shakeup is required, a vision and an ongoing commitment to education and training. This would benefit from the stability of a single point and body for coordination, open to all, housing a single base dataset from which other practices can build.

7.3.2 Barrier: Data Availability

Data availability is a broad term. It may refer to spatial features (points, lines, polygons, cells) or it may refer to the GI associated with them. Since the research began, there have been several, major developments in terms of data availability. The ONS continued to provide increasing amounts of spatially referenced social and economic GI and sophisticated modeling tools were being developed to make spatial generalizations and projections possible. The WG and the DU also provided increasing amounts of social and economic data. The ONS's Virtual Microdata Laboratory now provided a facility for providing secure access to sensitive detailed data for statistical research purposes that serve the public good. The UK data archive and the SAIL were making sensitive information available for research purposes. The problem being that those in LAs were struggling with the resource and time to participate in simple communicative mapping let alone risk exploration from which there may be no guaranteed return.

The ONS released another urban, rural classification for the UK and this was based on the output area geography. In addition, a new Rural Development Plan for Wales had been released, based on the ONS definition and incorporation of sub-LA geography and data. Therefore there were multiple definitions of rural.

The Census 2011 had been conducted and released and there was a new influx of social and economic data. However, many of the spatial units used for dissemination had changed. Not so much in name but more subtly in spatial extent and method of aggregation.

In addition, a PSMA had become operational, providing many within the public sector access to OS products without direct charge. Many other open data products were also becoming released and volunteered information (e.g. mySociety⁵⁵) and the availability of spatial multimedia (e.g. Street View) were commonplace. This was

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⁵⁵ www.mysociety.org

partly due to the increase in mobile technology that brought together GPS, maps and a seamless network of interlinked devices.

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"Maps are only as good as the data behind them". (A1)

The ways in which GI have become available are mainly linked to the initial work of the OS in mapping out what counts as valid knowledge when thinking about space. The OS have set the rules and conception of space upon which many mapping activities have taken place. The topographic maps of which many in the UK have become familiar favour the display of land over people's activities. As such, when boundaries are created upon these topographic maps, the boundaries too build on this chain of logic. The fact that the OS in the UK has become an obligatory point of passage for knowing about spatial problems has consequences for the scientific visualization of rural statistics. The OS has provided the platform upon which boundaries are created and territories defined. As the boundaries and territories used in mapping are partly for control and partly for calculation, all that flows from them is also part science and part politics. Increasingly, however, mapping activities have taken place under the veil of scientific method; hiding the politics and cultures that had a hand in their construction.

A UK wide mapping initiative and the construction of standard digital geographic boundaries for use in policy making has provided organisations in Wales with a common choice of units. Despite many of these units functioning well at a national scale, they are not always as useful at the local level. The problem mainly relates to uneven distribution of the population and causes certain boundaries to be more or less useful and abundant for local analysis. In rural Wales, the areas boundaries encompass are larger and there are fewer. The same land area in urban and rural Wales may contain five units in an urban LA and only one in a rural - mainly because of the distribution of the underlying population and settlement structure. There appeared to be an awareness of this issue among practitioners and the issue appeared to be somewhat accepted. This meant that by all organisations having to use consistent units, some areas were put at a disadvantage in terms of their options for representation and exploration.

The consequences of larger units in rural areas have become clear and can cause some issues to become overemphasized but similarly cause others to become lost. However, the smaller size of the units in urbanised areas can also hide social and economic issues. The problem with aligning social and economic statistical data to these areas is that certain topics are constrained for reporting just because of the nature of the topic. The data is only available for certain aggregations. Therefore, the representation of social and economic statistics within maps is as much a battle over legitimacy of information as it is of communication.

There was scope for interviewees to modify the collections of units used so that they could be combined and rearranged to fit particular needs. This was possible because most of the available boundaries had been designed to nest within each other's borders to form a spatial hierarchy. In practice, to construct new territories, those required in rural definitions, or planning areas, the predefined suite of existing administrative and statistical units were exploited. A selection of these common coterminous areas could be aligned to form a new whole, for example, a rural space. Organisations reacted to these boundaries (they held the information to make decisions) but were also aligning to boundaries (LA working to larger Health boundaries as part of LSB). The people working within them dealt with the issues of changing data and changing maps.

Spatial boundaries appear to be increasingly framing the way in which policy makers know about the population. What appears to have constrained the availability of data for the representation of social and economic statistics in rural areas is the lack of a single list of household units upon which social and economic statistics can be built. Legal issues related to protecting the privacy of individuals appear to have constrained this to some extent, but so too have political battles over access to certain types of data as a 'public good'. A lack of resolution between the OS, LAs and the Royal Mail has hindered development until recently within the public sector. The PSMA in Wales appears to be stepping in the right direction and so too the establishment of the SAIL databank. However limited people had the ability to maximise the potential for exploring LA need (lack of awareness and time consuming to access).

A future research area is emerging that entails the detailed mapping of personal characteristics linked to the household unit. This is beneficial for the scientific visualization of rural statistics as it frees social and economic information from the

constraints of larger boundaries. Despite still statistically tethering information to one point in space, it is a useful building block for focussing on the aspect of time. Finally, it becomes possible to hold the spatial dimension constant and start to vary time. In the past, this has not been possible in rural areas, due to the changing nature of boundaries. Adding the dimension of time to maps necessitates in most cases the need for animation and this brings about a need for scientific visualization.

7.3.3 Barrier: Data Linking

Excusing the play on words, this theme is very much linked to the availability of data. Improving the mechanisms for data interoperability means value can be added to existing GI more easily and this increases the amount of data available. However, improving data linking is very much associated with increasing awareness and coordination amongst those with a common data interests.

The problem was that many of the units used for data collection had changed. Even the core building blocks, the output areas, had changed. This meant that any analysis of change between census periods was difficult and, from a practical perspective, created difficulties comparing datasets. In addition, a new code system had been introduced that was not consistent with previous census years. Therefore, lookup tables were required to match even the simplest of geographies, such as LAs. Even the spatial extent of these had changed subtly in some areas (e.g. south Powys/north Merthyr Tydfil).

Web 2.0 has made the linking of data easier and now enables users to interact and collaborate with each other via some sort of social media platform. The users generate, create and manipulate content in a virtual community, in contrast to passive Web sites where users simply view information. It has led to a plethora of digitally mediated social networks. There is also blogs, wikis, tagging, video and photo sharing, hosted services, Web applications, and mash-ups. Google Earth, Bing maps, Yahoo maps and other commercial online maps have increasingly enabled the linking of spatial datasets outside of traditional geospatial platforms (e.g. desktop GIS). However question marks have been raised over the accuracy and quality for policy making.

Open initiatives were the exception rather than the rule regarding GIS prior to this research commencing but appear to have grown exponentially in importance. There

are now open data, software and associated standards. The WG is beginning to incorporate open source products in the services they provide. The development of a common language and compatibility between existing GIS software companies, the OS and the likes of Google Earth, mean that open source products have become increasingly important for policy making organisations. The issue is that these open source products require technical experts if they malfunction. The associated support provided by the market leaders is not then available. Nevertheless, the Open GIS consortium and the Open Source Geospatial Foundation exist to support these initiatives.

Many suppliers are now starting to offer Internet-based services as well as, or instead of, downloadable software and/or data. These can be free, funded by advertising or paid for on subscription; they split into three areas:

- SaaS Software as a Service: Software available as a service on the Internet
- PaaS Platform as a Service: geocoding or analysis/processing services
- DaaS Data as a Service: data or content services

The PSMA has enabled data to be linked more easily between public sector organisations by removing many of the licensing and cost barriers associated with GI. Despite now having a distinct address base for the UK, this is still not open to the wider public. Continuing difficulties occur when attempting to match addresses within the Address Base due to the complexity of the linking process.

In addition, this type of information is not freely available to the academic community and this could have the consequence of not ensuring that future generations are trained in this area. Without this type of skilled workforce, there is unlikely to be much progress in this area - despite increasing calls for collaboration amongst sectors. For collaborative mapping activities, particularly in rural Wales, there is a need to make the process of linking household locations to a common and definitive address base - that is universally accessible - the focus. It seems that this is the basis for future social and economic data linking, not the unit postcode.

Currently, it seems that much data linking is being done by area or thematic-based hubs, e.g. InfoBaseCymru and LSBi. The problem is that these observatory-based portals make it difficult to link and overlay additional spatial data.

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The technical problem of data linking now appears to have become easier especially within distributed GI systems. However, the ability to link data is more reliant on a new skillset. What used to be a data structure and database issue is increasingly becoming one of Web architecture.

As a result, there are now scenarios where it is technically straightforward to link data but other conditions where it is much more difficult. It tends to be that the closer the data to the household unit, the more difficult it is to link and fluctuate most over time. However, access to the skillsets required for these different mechanisms for linking also varies. Linking this detailed GI is required to improve the representation of rural statistics and there is a need to improve techniques and training for these activities. This could prove useful due to the frequent ways in which government boundaries change and are often regrouped.

At present, much of the social and economic statistics used for policy making occur at a level where simple data linking is possible or where the social and economic statistics have already been linked to a spatial unit. This means that ability to link data rests to some extent on the knowledge of what GI other organisations hold. Therefore, metadata is also important for data linking. Metadata could be a good platform for highlighting issues with representing social and economic statistics at certain geographic scales and with certain boundaries. Perhaps this could also carry warning signs for the use of certain datasets in representing rural Wales.

With data linking becoming easier, it means that more people will potentially be able to bring datasets together. How the suitability of doing so can be assessed is less well-known. In addition, the ease of linkage for some units might perpetuate the use of certain units over others, which could have consequences for how rural Wales is represented.

If the DU in Wales increasingly conducts data linking then this organisation is best placed to set the guidance and standards for how rural statistics should be linked. However this does not presently appear a priority, as they are too busy dealing with other issues.

In addition, linking could also refer to the ways in which places can be linked via the use of multiple representations at the same time. Again, if the DU is coordinating

data linking, it is best placed to link and disseminate multiple representations and additional data sets. There appears to be a fear over putting off customers but as Dorling has stated we do not learn through familiarity.

Another relatively recent issue in terms of data linking is the dimension of time. A stable unit for linking is required if time is to be studied as a dimension when mapping rural statistics. This is currently only possible as snapshots in time and for larger spatial geographies. If movement within and between places is to be measured then having a core spatial surrogate (e.g. the location of households on a grid representing space) to contrast relative position is important. This is particularly true where government surveys and administrative records need to be brought together at one place. The sequencing of events to reflect cause and effect could be important for exploring new dimensions within social and economic statistics. Related to this is the ways in which definitions can vary between organizations and over time. Rural statistics hinge on definitions and therefore this adds additional complexity to data linking when using 'fuzzy' definitions.

So, in summary, data linking appears to contain several interrelated dimensions that can cause and affect the practices of how rural statistics are represented. It is not clear how they are all connected.

7.3.4 Barrier: Increasing Awareness, Education and Training

The impact of online data providers and the rapid diffusion of mobile and Internet mapping applications have reignited interest in the combination of geography and technology. In 2008, GIS earned a place within the national curriculum and in Wales it forms part of the ICT requirements of the geography syllabus. Resource restrictions continue to limit the use of GIS in schools, although recent developments in open data and software have done much to promote GIS for the next generation. In addition, collaborative efforts between schools and universities enable GI and GIS resources to be pooled, raise awareness and establish GIS education pathways. There still appears to be a disconnect between schools; higher education and the labour market and clearer career pathways need to be developed to steer GI aware students into key roles in governance. GIS does not seem to be a priority for the

Royal Town Planning Institute (RTPI)⁵⁶ for example. It is not essential to have skills in GIS to become accredited with an RTPI qualification.

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Despite many organisations interviewed having small GIS teams, in Wales it was found that only a small network of people were trained in mapping social and economic statistics. These individuals acted to siphon the multitude of spatial evidence on social and economic issues for use both internally (certain people and departments within the council), and externally (with partnerships and the public). In general, the mapping of social and economic statistics did not appear high on the agenda for many LAs as much of this work was being outsourced. Instead of building capacity and skills within the organisation, the work was increasingly reliant on one particular organisation for mapping social and economic statistics. The DU sought to fill the gap between mapping specialist and the layperson with a stake in policy making. The organisation offered a solution using standardized Web mapping tools for representing social and economic statistics within interactive choropleth maps. The difficulty was that there was no explicit consideration of rural statistics within these maps other than the standard boundaries used in their display. This meant that for those attempting to explore social and economic statistics in rural areas there was limited scope to do so beyond the standard boundaries and definitions.

Therefore, improving education and training in mapping and GI is perhaps one of the most important areas in terms of improving the representation of rural statistics for policy making. This is because area based initiatives are increasingly being used to frame policy problems and target resources to so called 'hot spots' of need. Using this approach it is difficult to explore the sub boundary issues that may, when summed together present a significant social or economic related issue. Just because they are not clustered within a random area does not mean the issue does not exist. This is not the most straightforward concept to grasp without exploring the data further. Improving education and training may therefore help to help target resources more efficiently based on people rather than simply the characteristics of places.

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⁵⁶ The principal body that represents and supports planning professionals in the United Kingdom and Ireland. It promotes and develops policy affecting planning and the built environment and sets professional standards by accrediting planning courses nationally and internationally.

Several interviewees were carrying out routine practices that could easily be automated. Rather than exploring the information it was simply churned out to communicate what had previously been looked in a spreadsheet. More effort was place on communicating where the statistical spaces were relative to familiar local places, suggesting an often-local audience. Rather than use geovisualization to explore the data, it was simply presented as fact within LAs in most cases. Using techniques deemed unfamiliar (which appeared to be anything that fell outside choropleth maps e.g. a cartogram) were deemed not appropriate through a fear of confusing an intended audience. There was evidence of explorative mapping but this tended to be in the minority and linked closely to projects undertaken by the WG. Public sector cuts were noted as being instrumental in limiting the amount of resources available to devote to education and training (as money needed to instead be channeled into keeping frontline services running such as the health service and schools).

What was clear was that learning and skill development mainly occurred within the workplace through trial and error. Many common practices had been developed and sometimes circulated by word of mouth and between working groups rather than through formal training scenarios. Many had developed a skill in using mapping to persuade of a particular need in an area. In some cases, the skill base within the WG was contrasted to that of LAs.

The main issue appeared to be that much of this in-house knowledge was lost when employees left the post for whatever reason. As learning appeared to not be formalized, there was limited scope for role succession. The education and training required for mapping social and economic statistics should not be limited to just learning the software. A detailed knowledge of GI needs to be developed as well as an understanding of local issues, polices, rules and regulations. The issue is that all of these factors were frequently subject to change.

7.3.5 Barrier: Research and Development

Since research has increasingly become multi-disciplinary in line with the stakeholder community, now a focus has developed around shared vocabularies and unifying methods for data interoperability (e.g. INSPIRE). There is also a renewed technological focus on distributed systems.

Research has also begun to focus on the pragmatics of how technological developments can be assimilated in practice. There is now a clear focus on open source and web based mapping with many now integrating traditional GIS with Google Earth and the like. This has brought about new research areas such as how to capitalize on crowd sourced information and appropriate integration. There has been a shift from capturing snapshots in time towards capturing dynamic data flows. Web location-based services and dealing with the time dimension are relatively new research areas as is the integration of sensors, mobile technology, and volunteered GI. There is a growing awareness that the end user is no longer the technological 'guru' that they had to be in the past and therefore user-friendly interfaces and processes are being developed to bring analytical capabilities to the mass market (e.g. drive time analysis and geocoding).

In addition, the global economic crisis has called into question the future of the UK Census. Developing spatial data infrastructures and maximizing the use of existing resources is therefore becoming a critical research field. As such, research has developed on alternative ways of gathering geographic information and linking it based on the household unit. This involves linking together administrative, health and government surveys using addresses. There is still not an open source address base, which results in this work being confined to public sector bodies.

Spatial data modeling is still popular and the field of geovisualization has quickly become a significant area for applied research by GIScientists. It is also of relevance to human geographers more generally in how they engage with spatial media (Dykes et al., 2010; Thielmann, 2010). Geovisualization has been claimed as a significant advancement in mapping (Dodge, 2014) and has also been claimed to be 'the most important development in cartography since the thematic mapping "revolution" of the early nineteenth century.

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The problem is that much of the research and development remains disconnected to the experiences of those working in policy making organisations. As a result, much research goes unnoticed and only becomes incorporated within organisations when it meets a specific need and by that time the industry had moved on.

There has been limited research and development in to mapping rural statistics. Although a body of knowledge has been developed within national rural observatories. This research aims to help fill the gap to act as a sensitizing device for future research on this topic.

What is clearly emerging is the need for further research into how mapping can function in explorative collaborative environments and how this should fit within the policy cycle. It would also be beneficial in terms of representing rural statistics if research area could be developed that explores the linking of data at the household level.

7.3.6 Summary

Firstly, despite their being a host of scientific visualization techniques there was limited evidence of their use for policy making. There appeared to be several interlaced reasons. The most important was related to the scale and availability of data. Related was a second reason; there was limited training available for mapmakers in the appropriate use of GI and there was limited evidence of continuing professional development in applying GIS. There was also a wider issue in that most representations had an intended audience. Interviewees suggested they would lose the interest of this audience, because they would be deterred from anything unfamiliar. Presenting information in a familiar way has consequences. Areas with sparse populations tended to be larger in order to contain an equivalent population to their urban counterparts. As some LAs contain mainly sparse areas, it results in fewer units, which need to be represented. It also means that less detailed exploration was possible in these areas, as the data was not disaggregated into smaller units and made available.

It seems that for policy making it is easier to convince using the familiar than it is to justify the use of the unfamiliar even when it may be more suited for displaying certain issues. Perhaps now that items can be dynamically linked, and there is potential to display more than one representation of the same phenomenon (on the same screen) a change of culture might be encouraged to the way in which social and economic GI are understood within maps? It is clear that the constant resort to political, administrative and even statistical boundaries just does not work for representing social and economic data in rural Wales.

This thesis began and ended with an interview at the DU. During this period, much had happened to effect the ways in which rural statistics are represented. Many of these events have mobilized the DU as a key player for mapping practices in Wales:

- 1) Recession
- 2) Change in policy making powers in Wales
- 3) PSMA and Open Source data, software
- 4) Change in UK Government
- 5) Changing governance structures e.g. LSBs
- 6) Changing working practices
- 7) Changing staff
- 8) Changing laws and guidelines
- 9) Changing technology e.g. distributed GIS and mobile tech
- 10) Census 2011 and subtle change to multiple government surveys
- 11) Changing boundaries
- 12) Changing definitions
- 13) Changing methods
- 14) Changing demographics, economic structure and social-cultural composition

This list is not exhaustive and in any case generalises the problems. Perhaps amongst all this change it could be forgiven that little development has been made in the scientific visualization of rural statistics. Much effort is spent reacting to the range of issues that arise and affect current mapping practices. Education and training appear to be one of the first cutbacks during times of financial austerity.

7.4 Established Mapping Practices for Rural statistics

The research discovered that maps were being used in multiple ways for policy making. These processes have been summarized in Table 7.1.

Corporate mapping was used to help LAs in many of their statutory duties. This form of mapping appeared to have priority explorative mapping was minimal and relied on experienced staff, communicative mapping was more common in an attempt to display social and economic statistics. Diffused mapping was a reaction to the lack of capacity at LAs and designed to encourage those making evidence based decisions to use the standards incorporated within the technology. Token mapping refers to the people within policy making who use utilise map-based evidence be it through a static map or an interactive Web map. It is here that maps are put to use in

a presentation format. The map acts as a vessel for the issue, that which needed to be demonstrated.

It is clear that there are a variety of mapping processes and uses within LAs and the WG. Moreover, these are simply generalizations for emphasis. In fact, there was much variation within and between organisations in terms of how these processes were conducted. Each type of map used emphasises rural issues in different ways. Most practices encountered were focussed on the communication of information rather than its exploration. Maps were being used to sell an issue but the problem was that few were selling rural social and economic issues. Those that were, tended to sell them in a misleading way.

Table 7.1: Overview of Mapping Practices

| Corporate mapping | This type of mapping is mainly concerned the technical aspects of data collection, data creation, maintenance, and dissemination. This type of mapping took account of formal legislative procedures and copyright issues, etc. Basically, GI was created to serve common goals of the organisation. The types of data mapped were mainly fixed assets, such as household and service location or land use zones and planning areas. | |
|-----------------------|--|--|
| Explorative mapping | Here maps were put to use to solve spatial problems. Social and economic statistics were incorporated in highly dynamic and interactive environments both in terms of human computer interaction and collaboration between interested parties. Few staff had experience of this type of mapping. Those that did were enthusiastic advocates of GIS and mapping in general. In this case, mapping required detailed knowledge, not only of GI and how to operate a desktop GIS but also experience of the issue to be tackled. A mix of technical expertise and local subject knowledge was required. | |
| Communicative mapping | Here mapping took place as if part of a ritual. The process was very much a one-way process and the map was used as a communicative device. It was an alternative method to presenting information in a table. Here the focus was on techniques to present the data rather than explorative techniques. This was perhaps due to a lack of training in being able to manipulate the data further. | |
| Diffused Mapping | Here much of the early stages of the mapping process had already been completed. The spatial units and the social and economic data are presented in a pre-packaged format. These components are integrated and loaded within a distributed GIS system and available to a wider audience. This type of | |

| | mapping is similar to corporate mapping but is targeted to represent social and economic statistics |
|---------------------------|--|
| Token/end-user Mapping | Finally, there were those who had specific knowledge in a certain policy area but were lacking either the skill/knowledge to manipulate GI, to operate GIS or both. Perhaps they may have the expertise but were lacking in the time. Regardless, mapping here took place based on maps in their final presentation state. There was a token level of interaction available but it mainly involved a colour scheme or determining the number of partitions. The WLGA promotes the use of InfoBase systems in this scenario. Here mapping can be used as a form of evidence but only simple questions can be asked of the data, such as how likely something is to exist in certain areas. |

Reflecting on Cartography³ (Figure 2.7) reveals that most mapping uncovered was an attempt to communicate but that many of the issues did not necessarily adhere to the confines of the cube. There were many more factors at play and moreover there was variation even within these mapping themes. Some LAs may well be involved in certain mapping processes but both the culture of the organisation and the data available effect possibilities of map use. In addition, even the nature of the topic under investigation may limit analysis to a greater degree in certain jurisdictions. The agency of the mapmaker can in turn create further fragmentation. This complexity shows why it is difficult to standardize mapping practices.

As LAs begin to work together, mapping activity will most likely follow suit (mapping specialists from departments in different organisations working together to produce maps) and so too the aggregations of data held within them. However, in terms of rural statistics, it is important that the detail of the data held within these areas is improved, not diminished. After all, just because the function of organisations change does not mean the underlying data should. In addition, it is important to consider how the grouping together of certain LAs contextualizes rural places within the surrounding areas. Would it not be best to pool all mapping expertise and resources and explore each area with the most detailed information available that can then subsequently be anonymised after the needs and funding has been assessed?

What was found in practice, in terms of the way spatial social and economic data passed through and between organisations, contradicted some of the literature. For

example, Söderström produced a model visual circuit (see Section 3.3.2). Maps were deemed to contain an internal efficacy (within the organisation) and an external efficacy (for the public). What was found during the research was that very few organisations used mapping to simplify information for the organisation. Instead, external secondary data was being selected and brought within the organisation based on its external efficacy. Data was selected because of how it could be used and accordingly filtered to highlight the needs of a particular jurisdiction whilst removing superfluous areas. Zooming into the area of interest highlighted the jurisdictions need. The displaying of rural statistics was often perceived to be implicit within the data displayed rather than made explicit. However, in terms of the external efficacy, this local knowledge of rurality may be lost unless made explicit within the representation or supporting material.

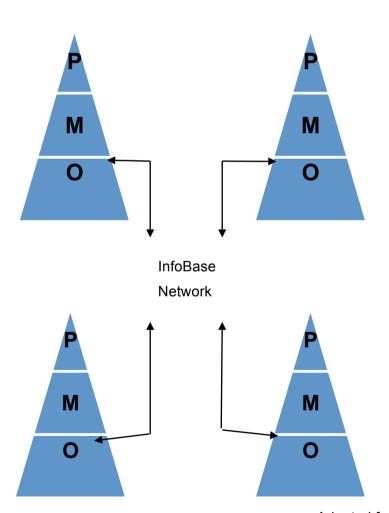
However, it was also found that this internal – external model was inappropriate in terms of how LAs and their partners were beginning to work in collaboration. For example, in the SW regional partnership an external organisation was being used pull together a complex array of data; simplify it and present it for use according to a particular theme. Rather than be used as an external persuasive device alone, the maps were being used within a compendium of data to coordinate action between organisations. This suggests that there is perhaps an intervening group efficacy that needs to be considered in terms of how maps are used for decision-making. This is likely to involve negotiation in terms of the interests to be displayed within the map. The outcomes of these negotiations may result in how rural social and economic statistics are considered within these mapping processes. Whose boundaries are presented, what definitions, which datasets etc.?

According to Mumford (2008), these interactions are not necessarily a bad thing. Instead of the maps being used to communicate known information, collaboration and communication is being used to bring together information (known to some organisations but not necessarily all) with the map being used to communicate a collective effort of interested actors (not necessarily the public). In this way, mapping can be an arena for learning about spatial problems and a means of reaching consensus. If this is to be the case, it is important that there is a rural voice within these map-mediated discussions to ensure collaborative action is 'rural proofed'.

In terms of the model presented by Reeves and Petch (1999) (where there are vertical information flows within an organisation) then there has been significant

change. These models do not necessarily now reflect what is happening in practice. In terms of the production of social and economic statistics, this has increasingly become outsourced to data-observatories that follow the InfoBase model. This means that much of the map production has already been constructed and the use of the map ensures that relatively high volumes of information can be structured for use at a managerial level. The local network can be created to share information that is private to the network as well as private to the organisation. This means that private information can be released according to tiers set within the system.

Figure 7.1: A Future Platform for Geocollaboration?



Adapted from (Petch and Reeve 1999)

This new configuration nests between the communicative forms of mapping and the explorative mapping found with LAs. It does not permit the fine detailed analysis required for exploring rural statistics but is slightly more interactive and standardized than the communicative forms of mapping. However, it is closer to the

communicative model than scientific visualization and therefore suffers from many of the technical problems with representing rural statics in a communicative manner previously discussed. The main problem being that the boundaries used to represent rural statistics are the same and there is less scope to overlay data layers and explore the uncertainty associated with the boundaries.

Diffused mapping using InfoBase systems offers much strength in overcoming issues outlined in the Chorley Report. The DU is well placed within the small mapping community in Wales to develop mapping practices at the local level in a distributed format. Just because the software and data are not appropriate now does not mean that they will be developed or replaced in the future. The important improvements made provide the mechanism for coordination and a focal point for instigating change.

7.5 Changing Mapping Practices

As information flows between and within organisations, it is distorted as it passes through multiple translations. If Forester (1984) is to be believed, some are inevitable and some are unnecessary and can be due to both local and global or structural factors. Investable local distortions can never be removed, as no best solution exists for mapping but could be militated against through improving display techniques and adhering to the semiotics of graphics (in context), and improving education and training in GI. Structural inevitable distortion can be mitigated against by open initiatives and improving standards; data linking and interoperability of representation so that all have access to the same information but will always persist. Distributed GIS and metadata could help to reduce content loss between organisation boundaries.

The problem is that unnecessary distortions are harder to tackle in a systematic manner. Precisely as there is no optimal map means that it can become used to deceive or highlight an issue according to one's need. Interposal bargaining unresponsiveness relates the local negotiations required to determine what goes into the map and how the maps are used as evidence. If few people are involved in mapping networks then these interpersonal negotiations are critical and impact on the organisations overall ability to map social and economic statistics.

Global factors that unnecessarily distort local networks are largely beyond the direct control of those mapping. However, these monopolies can distort exchange of information and the need for certain types of information in the first instance. They can affect the availability of certain data and the boundaries and technologies used for mapping. Raising awareness of where these imbalances exist, form an important starting point to begin a challenge to these unnecessary distortions.

As many of the issues of communicating in planning are mirrored in the production of maps, perhaps like planning the processes of mapping should be a collaborative process whereby maps are formed through deliberation and exploration. If collaborative planning results in better outcomes for places, then collaborative mapping processes should result in better communicative maps. If not at least their weaknesses will be exposed and subject to further spatial questioning. It is important to always remember that what is placed on the map should not always be confined to spatial boundaries and may just as easily be drawn on to the map by hand.

If a new stage of geocollaboration is on the horizon - as indicated by the current changes in practice - it is important to consider how current practices need to change. How rural statistics will function in these new environments will need to be considered.

| Same time, same place | Bring stakeholders together to explore |
|---------------------------------|--|
| | and discuss map mediated spatial issues |
| Different time same place | Build up map, based on underlying data |
| | in stages. Map evolves (potential to |
| | remove the privacy issues of exploring |
| | sensitive data by creating access levels). |
| Same time, different place | This removes the necessity to have local |
| | technical experts and removes access |
| | barriers if frequent interaction is required |
| Different time, different place | Expertise can be provided on an ad hoc |
| | basis but makes joint explorative |
| | processes difficult. |

These environments could well be used to help design rural places, assist in decision support and perhaps, most importantly, be used to generate ideas and explore

options. The fact that these activities are collaborative means that there is not necessarily the need to restrict options to what can fit to geographical boundaries and may well entail other ways of knowing. Information could be volunteered from the public that may sit outside current planning and political agendas that may be just as important for these places.

A framework for these types of activities would need to be developed for practice. Getting the practical details and theoretical detail in place before jumping the bandwagon and using the existing technology is essential. Moreover, these processes still require an element of central coordination and, to some extent, are still framed by existing geographical boundaries.

To go forward with this type of geocollaborative environment would ensure coproduction in developing public services. It would also ensure maps are more likely to be true, sincere and legitimate within a normative context. The important point is that the process would be scalable and would be reflective of the values at that time. It could be developed based on a community (which in most cases contain limited private or confidential information anyway, e.g. 'Doris has got a bad leg') but does not necessarily require face-to-face meetings. However, to ensure a suitable outcome requires diverse audiences who each have equal opportunity to contribute and multiple impressions of space can be incorporated. Then at a more strategic level for example, LA or Health Board, the culmination of data can be used to set priorities and target intervention. The WG would have a role in terms of raising awareness, coordination and channeling funds.

These environments would create new places that are less adherent to boundaries for exploring issues and distributing funding. However, it is important to emphasise how important it is to establish a fundamental address list for this type of activity and include people with certain expertise in these processes: technical expertise, GI knowledge, statisticians, social/cultural researchers, policy officers, and legal advice. In addition, a range of stakeholders would be required as in collaborative planning.

7.6 Resolving Rural Mapping Issues in Geo-collaborative Frameworks

It is argued here that if geo-collaborative environments are to be used for representing rural statistics then certain principles need to be considered and lessons learned from previous research (as outlined in chapter 3 in the literature associated

with PSS and participatory forms of GIS). This body of research has shown the theoretical benefits of collaborative forms of mapping but has also outlined many of the barriers that frequently cause these systems to fail and remain in the research domain, rather than being utilised in practice for strategic planning and policymaking.

Suggestions are now made in terms of how geo-collaborative mapping could be organised in Wales. This is then followed by an example of how geo-collaborative mapping could function in practice (and how this could result in an improvement in representing rural social and economic statistics).

A lesson learned from the Chorley Report is that a central body to facilitate and align mapping practices can result in long term savings through a reduction in duplication of effort and resources. As such the following recommendations are made:

- A formal centre for mapping social and economic statistics is developed in Wales (akin to the OS in the UK although this organisation does not map social and economic statistics so perhaps more like the ONS in their program for mapping Census data).
- The cutting edge physical centre designed to engage with a range of people and inspire innovation and creativity (visually supported meeting rooms and computing network infrastructures) and can ultimately encourage inward investment around this hub.
- Coordination This needs to be top down in Wales to ensure consistency and avoid the fragmented approaches of the past by the Welsh Government.
- A formal policy and framework for action is developed (joint collaboration between research and policymakers) – increase awareness and develop a vision for the future.
- Access to the social and economic mapping services is made easy (e.g. a publically funded service, with support and advice readily available) and rewarding for those who participate (e.g. learn new skills).
- Develop a core team at the centre from the pool of existing specialists (including academics) in Wales with role specific responsibilities (e.g. computer technology and database specialists, statisticians, Web developers, GI experts, policy experts, etc.) that assist and support mapping processes (mapping together) in which each stage can be both urban and rural 'proofed'.
- Develop a core team at the centre (from the pool of existing specialists in Wales) with role specific responsibilities (e.g. computer technology and

database specialists, statisticians, Web developers, GI experts, policy experts, etc.) that assist and support mapping processes (mapping together) in which each stage can be both urban and rural 'proofed'.

- Projects managed on a case-by-case basis and lessons learned logged for future cases.
- Incorporates the latest cross cutting research and translates it for policy making purposes – to stay ahead of the game
- A variety of time/space options for participating with the centre (e.g. same time - same place, same time - different place, different times - same place, different times - different places) and tailored tools and technology to support participation (e.g. may need to run on minimal bandwidth)
- Simplistic and intuitive interfaces designed around the users needs with additional components incorporated on demand based on a distributed GIS
- Ensure appropriate protocols to enable people from different backgrounds to work together (e.g. collaborative planning) – to ensure mapping incorporates different ways of knowing people and places
- A single site for data integration, learning best practice, knowledge transfer and obtaining feedback
- An open source agenda (open data, open software, etc.) to reduce the financial burden and resolve some of the technical barriers.

Incorporating these principles in practice will ensure rural statistics and representation are improved for future generations.

The recommendations obviously represent an ideal scenario (with existing financial and political issues set aside) but nevertheless provides a vision for the future of collaborative mapping processes that could benefit the representation of population sparse areas (focussing resources and coordinating effort, promoting an explorative mapping culture for policymaking, by developing a platform of household level information, providing opportunities for learning and sharing GI, combining research and practice etc.) and remove many of the barriers and issues found in practice within this thesis.

To illustrate the benefits let us now think of a scenario and reflect on how collaborative mapping could function in practice. This would follow closely the key stages of collaborative planning (following Healey, 1997) in that the first stage would be about getting organised (assembling stakeholders and arenas for GI mediated

debate), next there would be a data gathering and engagement process (where protocols and styles of communication are outlined for GI sharing), followed by a stage of sense making (in which a common mapping discourse is established, what is to be utilised within and outside of the map frame), next consensus and solutions will be developed (types of analysis, forms of representation, sources of error), followed by a stage of utilization (in which maps are put to use to highlight and resolve social and economic issues) and feedback (in which lessons are learned and fed back into future mapping practices for maintaining consensus on mapping discourse).

Imagine there was a need to close a facility (e.g. hospital, school, library, leisure centre) in rural Wales and the social and economic consequences required assessment. As the issue contains a location dimension then geo-collaborative mapping may be deemed necessary for making a decision. Therefore a policy officer could contact the mapping centre (described above) and request advice and assistance. A library of existing practice-based examples could be searched for prior examples of this type of mapping using a meta-database and key words (e.g. rural or social or facility).

This could be used to assemble groups of known stakeholders (or developed based on previous experience) and matched with appropriate mapping specialists. From here the decision to proceed with a mapping solution can be decided and mapping statement developed (in which the aims of the process are outlined). In addition a steering group for the project can be assembled (to ensure specific needs are met e.g. the representation of people in areas of population sparsity) who develop a broader database of key contacts, set a communication strategy (that could incorporate social media etc.), agree project timescales, provide access information.

Once the scope has been defined and a project manager is assigned to oversee and facilitate proceedings, the debate can begin in terms of the factors that need to be considered both in terms of items to include within the map, the resources required and the horizon of possibilities. These debates should be open and transparent for scrutiny purposes.

A map template developed and data added either directly or remotely (crowd sourced) to build a repository of information that could be utilised (some of which may not necessarily have a geographic element). The public would be free to

physically come to the centre or be guided through the virtual centre to add information. White boards and 3D printers could enable planning for real interaction with aspects shown within the map (this could show for example that gradient may be an issue in terms of access).

Next the value of datasets is open for debate and discussed in terms of what should be selected and integrated for further analysis. Experts can be brought in to illustrate analysis options and demonstrate the tools available. Multiple views of the data are made available and displayed around the centre and in virtual galleries (that mimic the centre) for online exploration. Here for example alternative views of the data can be shown and discussed (using the framework outlined by Maceachren and Brewer (2004) in section 3.4.2). Statistical analysis can be conducted and explained for learning and development or integrated (as a black box) within user-friendly tools and interfaces. These are set in place to ensure wider audiences participate as well as form part of the consultation (in fact crowd sourcing ⁵⁷ could be used here in combination with the gamification ⁵⁸ principles applied to micro-tasks to, for example, gather data or create intelligent algorithms).

Data sources are then put to use and options and solutions presented based on prior consensus. The multiple criteria evaluation could be performed and contrasted with the status quo. It may be the case that no resolution is available (but this is important heuristic that could be fed back). The quality of the mapping solution can then be assessed, documented and fed back (discover sources for error through ground truth exercises linked to portable devices in the locality). This would create a repository of data, mapping solutions and learning resources that could have commercial value outside of Wales.

7.7 Limits of the Study and a Vision for Future Research

Despite offering a focussed lens on institutional practices in Wales, this thesis would have benefitted from being conducted on a full-time basis. Despite being carefully planned, the research had to, at times, be reactive to unfolding circumstances. This

⁵⁷ Goodchild, M. F. 2007. Citizens as sensors: the world of volunteered geography. GeoJournal 69(4), pp. 211-221.

The use of game design elements in non-game contexts e.g. McKenzie, G. ed. 2011. Gamification and location-based services. Workshop on Cognitive Engineering for Mobile GIS.

was sometimes difficult to implement while working as a research associate at Cardiff University. However, as the position was within the WRO, it also meant that an indepth understanding of rural issues could be developed whilst working.

As the research was conducted part-time, it meant that it was not condensed within a short period of time. As a result, an important longitudinal element was captured. This was found to be useful as it offered insight into the rapidly changing circumstances within policy making in Wales takes place. If a related study were to be repeated in the future, it may be beneficial to spend longer periods of time within the organisations under investigation. Although this would be extremely time-consuming and was not practical under the conditions of the current thesis, shadowing certain personnel during certain policy periods could offer further insight.

It would have been useful to be able to capture the activity on the screens of those demonstrating explorative mapping practices. This was not done as it was decided that it would have created a somewhat artificial environment and perhaps was something that could be done in future studies. In addition, there was the difficulty of incorporating this information within the thesis, the video could be attached on disk or hosted on a password protected website. However, it is then somewhat detached from the narrative. This poses a more general issue: How can human-computer interaction within explorative mapping practices be documented?

The focus of the study was mainly working practices within LAs, the WG and the DU. In reflection; it would have been beneficial to broaden the mandate by incorporating the mapping experiences of those on the periphery. Those who are less able to access technology and data made available under public sector licences.

Another issue is the generalizability of the study to other circumstances. Outcomes from case studies are not statistically generalizable but instead are analytically generalizable. Although the number of participants in the research was not large enough to be scientifically generalizable, the focus here was to provide 'full and thorough knowledge of the particular' (Gomm, 2000). The study could be used, therefore, as a sensitising device to compare how other countries deal with their rural statistics and to look for commonalities and contrast. Therefore, instead, a set of 'working hypotheses' have been developed that can be used in an attempt to describe other cases. Perhaps in the future, if necessary, a more comprehensive study could be undertaken on aspects found within this thesis but it was deemed

important to develop the theory rather than to generalise aspects that may have been of importance.

In many ways, it is felt that this research has provided a starting point for future research on the visual representation of rural issues for policy making. The research has provided understanding and deeper insights into the methods from which several sensitizing devices were uncovered for exploring the complexity of mapping rural statistics and a theory built. This section will make recommendations for further investigation as a result of the findings that have emerged from this study.

Firstly, there is a need to explore the main theory and findings emanating from this research in more cases. This may evolve to incorporate the work of those involved in policy making that have recently begun to map social and economic statistics making use of open source mapping software such as QGIS and utilizing PSMA. It would also be useful to explore differences within other parts of the UK at first and then compare between EU countries.

Secondly, there is a need to explore the concepts of this thesis in a largely explorative manner because little in-depth research had been previously conducted on this subject matter. Now that a more nuanced understanding has developed, there is scope to enhance the findings by adopting a survey approach to add rigour and objective reasoning to some of the findings. For example, this could involve a stock take (using a survey) of the skill base for mapping social and economic statistics in relation to career pathways. Another avenue may be to test different types of geovisualization techniques⁵⁹ (with those likely to influence policy decisions in Wales) for exploring rural social and economic data within a collaborative working environment to gain feedback and to develop a framework for collaborative mapping within policy making.

Thirdly, it is important to explore how new data linkage techniques at the household level can be incorporated in to policy related mapping practices. How this detailed information can be represented whilst guaranteeing anonymity appears to be a growing research area and is important given the calls to change the way in which the census operates. The detailed information needs to be explored as well as the key messages presented to a wider policy audience.

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⁵⁹ More advanced techniques may not help when there is barely the time or skill sets for basic choropleth mapping.

Fourthly, it would be important to investigate how other forms of representation can be used to indicate and highlight rural issues. Therefore, it is worthwhile building links with the field of Qualitative GIS to explore how this could be achieved.

Fifthly, a long-term longitudinal approach could also be adopted as many of the collaborative practices and InfoBase systems were in their infancy at the time of the research. It would be useful to keep track of how these develop and can accommodate alternative forms of data and representation. It will be particularly interesting to explore how distributed GIS systems could potentially connect and interlink with these centralized systems.

Finally, it would be worthwhile developing a series of recommendations in terms of how education and training could be developed in general but particularly for those entering policy making environments. It is evident that mapping skills are becoming an integral part of how policy making operates in terms of gathering evidence and measuring success. Therefore, there should be a requirement for all those entering careers in policy making and planning to have proof of education that accounts for a more nuanced understanding of the types of GI available and the ways in which these can be combined within HCI. A focus should be on the enduring principles that are less subject to change with additional modules that adapt according to changes in data, technology, and policy. It is less useful now to teach the broad concepts of GIS.

This thesis has been weighed down somewhat by the issues surrounding current mapping practices in Wales. But what if we now gazed in to a crystal ball and imagine what could be possible in the future if some form of coordination, funding and forward planning was devoted to improving mapping practices in Wales.

Now this may be unrealistic but what if in the future geo-collaborative environments (that incorporate volunteered GI, qualitative GIS, and data from Administrative Data Research Network) could be hosted at a mapping centre housed by the DU or added to the functions of SAIL. This could present a physical and network meeting place for detailed exploration in to hidden rural issues. There should be no reason why effort and expertise could not be pooled as a collective to deliberate and experiment how geographic information is included within maps. In so doing those with an interest could learn together either at this place or remotely via a networked interface.

A nationwide database of GI could be developed and a campaign of raising awareness of what is required in terms of data collection undertaken. It could be based on a core unit of household locations linked to a multitude of social, economic and environmental factors that was updated in real time. But also display animations of movement two and from households using volunteered GPS or mobile network signals, that could indicate when a bus was required or even show when a bus was arriving. It could be used to provide support to those in need and push services to where they may be of use. Multiple HCI could be designed to represent data according to different analysis purposes (cartograms, change in time, multiple variables). These could be loaded as modules for exploration and analysis purposes and shared within a wider network.

The establishment of a dedicated mapping centre could be used for coordination purposes. Planners, policy officers, and others could use it. Moving them from their desks and in to communities where the need is recognised and assistance is required. Perhaps by being linked via GPS to a central mapping centre where information about their surroundings is relayed via audio or visual headset (e.g. Google glasses) to the officer in the community may help both ground truth mapping content and relay information and experiences back to the coordinated body. Offering a dynamic between strategy and action. In this way people in the community could offer their experiences and issues of living in rural places. There may be many simple fixes that could be achieved in areas that contain people at risk.

The point being here is that what happens outside the map space is just as important as what goes on inside. Mapping may well be used in an explorative sense and navigate people to communities of need but at the same time these people can feedback information to the map and guide the map makers. Enabling them to refine their practice. Something that is not necessarily captured within Cartography³.

Now this may all seem far-fetched and a bit Orwellian but most these things already exist but much like this thesis they have not all been brought together. Perhaps putting forward and offering a vision for the future will help coordinate action and start the debate as to what mapping should be used for and what needs to be done to get there.

7.8 Summary Discussion

There has been limited formal research into the subject matter of this thesis: the representation of social and economic statistics in rural areas for policy making. Although this research draws upon several existing studies and investigations, it is unique in the way it has brought all these factors together to reveal that the issue is multifaceted and rests within several disciplines.

The fact that until recently there has been limited coordination amongst these factors for the specific purpose of mapping rural Wales has meant that progress has been piecemeal and fragmented. This is not to say that progress has not been made within each separate discipline, it is simply the fact that little improvement has been made in terms of converting these changes into the practices required for policy making. It is clear from this research that improving the representation of social and economic statistics is only part of the solution and, in any case, for whom is the representation improved? Obviously, good practice can be adopted in representation but with the realisation that this is but one of the many ways in which the data could be represented. This thesis has suggested that the social interactions, both locally and within wider networks and the resulting rules and resources, created shape the scope of what can be known about rural statistics within policy making. However, it also within these networks of relations that changes can take place. It is clear that in the future there will be a need to improve education and training in order to establish awareness as we move ever closer to an age of 'big data'. If we have learned anything from the Chorley Report, it is the need to establish an open, fundamental tethering point to link social and economic statistics and there is need to coordinate action and awareness to ensure the public, private and voluntary sector, as well as those in the general population, can work towards a common goal and avoid wasting resources.

This thesis has, hence, attempted to present a framework within which all relevant disciplines can work towards a common understanding of how they can learn to explore rural issues within policy making and the points at which there is likely to be a need to develop knowledge of the relationship between both theory and practice.

It is the recommendation of this research that for mapping practices to improve in Wales there needs to be careful consideration to the variety of ways in which mapping processes operate in everyday practice. It seems that for rural Wales some form of collective mapping approach is beneficial for exploring social and economic

statistics and building capacity. This needs to be more than some form of participatory GIS; it needs to be a collaboration of expertise who deliberate and explore spatial problems based on an ethos of collaboration rather than competition. Communication should be not just be the output of mapping practices and should occur throughout the whole mapping process between people. This will require a vision (that incorporates the need to rural proof mapping), a common data framework and most likely an open address base (i.e. UPRN) upon which other data can be built upon over time. This will most likely require a rethink of how privacy legislation operates during certain contexts. In addition, it is important that this form of collaborative mapping acknowledges all forms of information not just that which can be quantified. What becomes classified as geographic knowledge is then open for debate.

It seems that moving towards this type of data framework could improve the representation of rural statistics for policy making. It will then be able to offer policy makers the ability to visualize what may have previously been hidden from the policy radar. Hence, a change and a learning process can begin, ensuring there is justice in society - regardless of where you live.

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The development of GI strategies that affect mapping in Wales

Despite digital policy developments in the UK until recently it has remained unclear how GI operates explicitly within e-government. Therefore a key challenge remained in terms of integrating geographic information with other types of information in the different types of processes supporting interaction between public administrations, businesses and citizens. Vancauwenberghe et al. (2014) suggests the integration of geographic information and services in a broader e-government can be mutually beneficial. They describe the relationship between e-government and the use and management of geographic information as symbiotic: while e-government can provide a significant boost to the use of geographic information, the use of this geographic information can be an important enabler for e-government.

The EU INSPIRE directive has instigated many of these developments.⁶⁰ In that it has effectively forced the hand of governments in the UK to develop spatial data strategies and offer guidance for achieving these networked data infrastructures.

INSPIRE - INfrastructure for SPatial InfoRmation in Europe

This directive sets out a general framework for a Spatial Data Infrastructure (SDI) for the purposes of European Community. Its prime objectives are data exchange, data sharing and data re-use, for effective governance and policy-making purposes (AGI, 2009). INSPIRE is more geared towards environmental sustainability than local social and economic concerns. The directive came into force in 2007 and covers the themes shown in Table A1 below. Notice how social and economic statistics constitute the minority of themes.

INSPIRE is European legislation to which the UK and other EU member nations are bound and is being rolled out in several stages with full compliance required by 2019.

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⁶⁰ 'Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007, Establishing an Infrastructure for Spatial Information in the European Community (INSPIRE), available from http://inspire.jrc.ec.europa.eu/index.cfm

The Department for Environment, Food and Rural Affairs (Defra) leads on the transposition and preparation for implementation of INSPIRE through the UK Location Programme. The WG has also ensured Wales has its own guidance.

Table A1 - INSPIRE Priorities

| Annex I | Annex II | Annex III |
|-------------------------------|---------------|--|
| Co-ordinate reference systems | Elevation | Statistical units |
| Geographical grid systems | Land cover | Buildings |
| Geographical names | Ortho-imagery | Soil |
| Administrative units | Geology | Land use |
| Addresses | | Human health and safety |
| Cadastral parcels | | Utility and governmental services |
| Transport networks | | Environmental monitoring facilities |
| Hydrography | | Production and industrial facilities |
| Protected sites | | Agriculture and aquaculture facilities |
| | | Population distribution – demography |
| | | Area management /restriction/ regulation |
| | | zones and reporting units |
| | | Natural risk zones |
| | | Atmospheric conditions |
| | | Meteorological geographical features |
| | | Oceanographic geographical features |
| | | Sea regions |
| | | Bio-geographical regions |
| | | Habitats and biotopes |
| | | Energy resources |
| | | Mineral resources |

As much of these data could be used as contextual evidence or performance data it is likely to affect local government, as data users as well as data providers. According to a survey conducted by the Local Government Association (2014) there will be likely impacts in community strategies, planning and localism, development and regeneration, housing, traffic management and transport, strategic environmental assessments, environmental protection and conservation, emergency planning. Therefore although very much geared towards EU priorities and environmental objectives there are likely to be indirect implications for the use of social and economic statistics in the UK.

To implement INSPIRE in the UK requires removing barriers, so that interoperable data (with seamless metadata) can be shared and harmonized across the public sector. To do this requires the creation and promotion of network services and facilities that can be easily found and used by public bodies. An on-going process of

ccoordination, monitoring and reporting will also need to be set in place (Local Government Assocaiation 2014).

INSPIRE appears to demonstrate a European push towards making spatial information mainstream. There appears to be a gap in terms of social and economic data integration. Environmental and the more physical elements of the Europe seem to have taken priority and treated as if they are more fundamental despite issues such as migration and health dominating the headlines.

At the same time as the European push for standardisation the Wales Government, Westminster Government and UK Research Councils were all encouraging social science researchers to use existing sources of data if possible. However a metadata catalogue for social and economic statistics in Wales has until recently been lacking.

The Welsh Approach to GI strategies

Even before the UK strategy had been released Wales had begun a journey towards using GIS for policymaking and planning. A survey by AGI Cymru in 1999 revealed that there was a certain amount of GI activity across all sectors in Wales. But there were also some major blocks to fully enabling the potential of these tools. In terms of developing a specific GI strategy in 2003, Wales was ahead of most of the UK. The Minister for Economic Development in the Welsh Assembly Government played an important role in instigating this process. In the AGI (Association of Geographic Information) Cymru conference in 2001 he challenged the GI community to identify how Wales could make best use of GI. Subsequently a strategy was developed to raise awareness and highlight the benefits of GI and geospatial technology to organizations in Wales. These benefits included savings in terms of time, manpower and finance. This marked a clear recognition of the potential of Geographic Information for Wales. However despite bold claims of efficiency and economic savings the document failed to outline how in practice this should be achieved. Instead the report focused on a multitude of issues that first needed to be tackled (see Table A2 below). An action plan was developed in 2003 to tackle these issues. Many of the barriers were not unique to Wales and were reliant on a wider government framework and operational mechanism being in place. However the realization that the GIS community in Wales was small meant that many projects and initiatives could be implemented quickly.

Table A2 The National GI Strategy for Wales 2003-2008

Addressing GI barriers in Wales

- Avoiding Duplication of Effort
- · Promoting, and Learning from, Best Practice
- Adopting Common Data Standards across Wales
- Providing Guidance on Confidentiality Issues
- Promoting the use of Data Locators
- Encouraging the Exchange of Data
- · Providing Guidance and Promotion for 'Joined Up' Working
- · Having Leadership for GI
- Applying Metadata Standards
- Dealing with OS Issues
- Promoting GI around Wales
- Providing Guidance on Strategies

While this was underway e-government was entering another phase. Emphasis was placed on addressing cultural and organizational barriers, which hindered some of the technical aspects of e-government processes. A resulting *Transformational Government—Implementation Plan* outlined the role of GI and how a framework to guide regional and local geographical initiatives should be established. As a result Ministers asked the Geographic Information Panel to create a UK Geographic information Strategy. The aim of the strategy was to maximize exploitation and benefit to the public, government and UK industry from geographic information and to provide a framework to assist European, national, regional and local initiatives.

Similar to the GI strategy for Wales the UK GI strategy helped to resolve GI issues for use in policy making and planning. It aimed to do so by establishing core reference geographies for the UK, removing barriers for data exchange and metadata access, and improving education, governance and licensing. The UK Location Strategy was launched in 2008 and contained implementation of the EU INSPIRE Directive. Subsequently a revised strategy for Wales was developed – Location Wales.

Location Wales is now the latest document for guiding the use and development of both GI and geospatial technology in the public sector in Wales. It sets provides a useful audit of the state of GI in Wales in 2009 and states seven strategic outcomes:

- · know what data we have, and avoid duplicating it
- use common reference data so we know we are talking about the same places
- share location-related information easily through a common infrastructure of standards, technology and business relationships
- have the appropriate skills both among geographic professionals and among other professional groups who use location information or support its use
- have strong leadership and governance to drive through change
- communicate and promote best practice
- deliver increasingly efficient, improved services, wealth and education

(AGI Cymru pg.1-2)

The strategy offers guidance in twenty-six areas for all those using GI and geospatial technology in Wales. It provides a coordinating mechanism for practitioners in the public, private and voluntary sectors as well as interested members of the public. However it speaks little of issues in representing rural statistics. In addition although the document is specific to Wales much of the content also applies to elsewhere in the UK. In fact much of the weaknesses and threats span well beyond the scope of control of the WG. Providing justification of the importance of the broader picture of e-gov within the UK in this section.

What is clear is that until recently there has been much confusion in relation to GI and geospatial technology use in Wales and elsewhere in the UK. Changing technology, policies, laws, standards, political boundaries, roles, groups, tasks, and the quasi-commercialization of some public sector bodies and data have left a fragmented operational landscape for anyone attempting to represent rural statistics using geospatial technologies.

Notes on Agency and Structure

In terms of furthering the discussion, a core concept is the role of agency and structure. These are seen as key philosophical underpinnings in terms of setting up a methodology to explore processes that take place within an organisation. These concepts have been juxtaposed within social science literature with actor-orientated approaches being the voice for agency and being critical of structuralist approaches to social research. Agency, although it generally refers to micro level actors, can also refer to macro level collectives that act. In other words, any social being, whether an individual or a collective, can has agency. Similarly, structure, although it usually refers to macro level structures, can also refer to micro level phenomena, such as human interaction. Thus, the definition of both structure and agency can refer to either micro- or macro level phenomena (Ritzer 2004). These are interesting issues in terms of this research as they reflect the stance taken on the role of scientific visualization and the relationship to and between the map maker and map user and the wider factors that affect mapping constructions.

Structural approaches in the social sciences are rooted within structure that affects agency. Structures determine agency. Actor orientated approaches attempt to overcome the this by exploring action, interaction, discursive impacts and the notion of multiple realities from an individual's perspective. Actor orientated approaches are therefore rooted in the idea of agency so that any structure emerges from the role of the social action and this, in turn, creates the conditions for further social action. Actions and outcomes in social processes are therefore down to the actors and not a social structure.

Theorists who have attempted to reconcile the difficulties of agency and structure include: Giddens, Archer, Bourdieu, and Habermas. Although each case uses slightly different concepts and disagrees on certain points, all attempt to bring together both agency and structure into one integrated paradigm (Ritzer, 2005). The best way to illustrate what is meant by agency-structure integration is the best-known effort found in the work of Anthony Giddens (1984, 1990) and his structuration theory. Broadly, structuration theory is an attempt to theorize the relationship between agency and structure. Giddens seeks to converge object with subject (human agent) in what was termed a 'duality of structure' (Bryant and Jary 2003).

Structuration

To examine the dualism between structure and agency, Giddens departed from the conceptualization of structure as some given or external form. Structure is what gives form and shape to social life, but it is not itself the form and shape. Structure exists only in and through the activities of human agents (Held and Thompson 1989, p. 256) Similarly, he departed from the idea of agency as something just 'contained' within the individual. Agency does not refer to people's intentions in doing things but rather to the flow or pattern of people's actions. Giddens deeply reformulated the notions of structure and agency, emphasizing that "action, which has strongly routinized aspects, is both conditioned by existing cultural structures and also creates and recreates those structures through the enactment process" (Walsham 1993, p. 34). He suggested that while structural properties of societies and social systems are real, they have no physical existence. Instead, they depend upon regularities of social reproduction (Giddens and Pierson 1998). He therefore explains how structures are not brought in to being by social actors but are continually being created by them, as actors express themselves in their social acts. However, whilst doing so, these social agents are not wholly knowing creators of structures as their actions have both intended and unintended consequences. Similarly, structures may constrain action or may, in the act of their reproduction, enable modification and recreation of the structure, when an actor utilizes resources to do something different within the structure.

According to Hall (1987), actors are more than individuals. They also include teams, groups, and organisations, but not societies or collectivities. He draws on the work of Hindess (1986), who defines an actor as "... a locus of decision and action where the action is, in some sense, a consequence of the actor's decisions." It seems the title of 'actor' is based on being able to formulate or make executive decisions, which by extension disqualifies less tangible and abstract social categories.

Actors and networks

Decision making is not the only characteristic of agency; it is also about being able to change the existing order of things. Latour (1987, pp. 108-120) suggests that this can be done strategically by translating interests. He suggests this can be done in several ways including the generation or manipulation of a network of social relations and the channeling of specific items (such as, claims, orders, goods, instruments and

information) through certain nodal points of interaction or obligatory passage points. These are interesting points to be explored in more detail in terms of this research. For example, how does the map metaphor act as a nodal point of interaction for actors dealing with social and economic statistics? To what extent do these actors become nodal points for the policy making network? To what extent are actions aligned and attributed to these nodal points in the arena of policy making? If different agencies and users are constantly in a game of translating technology into their own interests, what are the consequences of these transformations on the representation of rural statistics?

These questions suggest value in adopting an actor interface approach for probing the dynamics, predicaments and emerging negotiations inherent in processes of mapping rural statistics for policy making in Wales. To do so requires attention to the strategic interplay of interests, values, knowledge and sources of authority and power (Long and Liu, 2009) between social actors at a number of scales ranging from map maker to the organisation. This facilitates more insightful interpretations of the different responses to seemingly similar structures and processes of visualization-based intervention, where similar datasets are available and similar organizing principles have been set. Therefore, rather than attempting to explore differences between nation states at a macro-structural level where constitutional and organisational makeup, data availability, market orientation and broad social and cultural backgrounds may be different (Dühr 2007), this thesis is directed towards a close-up view of a specific arena⁶¹ of change. Through this, concepts may emerge using a grounded theory concept so that they can be tested under different contextual circumstances.

As suggested by Long and Liu (2009), this detailed type of study of a network of key individuals enables a more nuanced and vibrant appreciation of the processes in action. Such a close-up view can also highlight the many ambiguities and strategic manoeuvres utilized by the various actors in their struggles to reassert or redefine

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⁶¹ Arenas are defined as social encounters or series of situations in which contests over issues, resources, values and representations take place; these are social and spatial locations (e.g. pubs, and the market place and similar) where actors confront each other, mobilize social relations and deploy discursive and cultural means for attaining specific ends (Long, N. 2003. *Development sociology: actor perspectives*. Routledge.).

their priorities, social interests and network configurations. By using the versatility permitted within a case study, an exploration of these actions will begin. It remains for future research to take up the comparative challenge by identifying key research questions for comparison beyond Wales.

As maps have now been shown to be inherently social in character and visualization aligned to the individual rather than the public, it will be actor-inspired theories that will be used to orientate this research and uncover the myriad of social interactions that take place when rural statistics are represented for policy making. However, this research acknowledges that structure has a role in terms of creating rules and resources that constrain or enable certain actions. It is therefore at the junction of these modalities and social actions that this research will explore in more detail. It will be here where struggles are likely to happen between actors and over social meanings and ascriptions to specific items, events and ideas, over which representations are to count, and over who gets to represent a specific place in a certain way.

Theoretical Implications

It is clear that this research has revealed that the mapping of rural statistics is a complex process. As such, it is useful to reflect on broader theoretical frameworks that help understand how all the micro theories sit together within an overarching theoretical construct.

This thesis has utilised components of several qualitative approaches. Concepts of ANT were used utilised to organise and frame methodological action: ANT (Callon, 1986; Latour, 1987; Law, 1987). This was because it was an interesting way to focus on how to follow a problem in practice and think about elements of mapping are connected. ANT also contains many components for explaining elements of this thesis but was considered to contain too many radical concepts for advancing a discipline fixated on maintaining the status quo. In addition, the dense vernacular within ANT may deter any readings of this thesis amongst a wider audience. If cartograms are a difficult concept to introduce then what chance is there of convincing of their ability to act in the world and the need to treat them the same as humans? It basically comes down to an ontological decision, based on the autonomy of technical artefacts.

An overarching theory is capable of nesting almost all aspects found within this research, and therefore capable of nesting the findings of this research. This is the structuration theory of Anthony Giddens (1984). This theory can be applied to explain the interplay of map makers in relation to their contexts.

Structuration theory asserts that there can never be any universal and timeless sociological laws. This also seems to be the case for the mapping of rural statistics. The practice can change between organisations and even between people and, importantly, can change over time. Giddens suggests that people have the capacity for agency, and hence can change the very nature of social organisation – thereby obviating any social laws considered universal. The capacity for human agency is important in terms of mapping, particularly scientific visualization, as these are often based on the action of individuals. Therefore, changing technology is less of a concern: it is about how the individual has the capacity to react to this change and how they apply the technology.

The double hermeneutic (the idea that concepts used by social scientists can be employed outside the discipline, by laypersons, as agents, who can alter social processes) is a useful way of thinking about how the cartographic discipline and GISciences have been incorporated within policy making. In turn, policy making then can have affect in society and be influenced by it. Basically, this means those in policy making can alter their theories based on experiences and are receptive to incoming information. Therefore, scientific visualization holds the key in 'revealing the unknown' to transforming the very order which they aim to describe. This means that scientific visualization can encourage reflexive action, which has the ability to change the culture and structure of a situation, i.e. it can reveal hidden rural issues. Communicating what is already known is less likely to be transformative. Therefore, the act of using scientific visualization to represent rural statistics is by its nature a form of social criticism. This is because it is capable of contradicting established ways at looking at things and therefore calls into question the established ways of doing things.

The duality of structure, a key concept, helps describe how mapping is conducted. Active agents (i.e. map makers) utilise and operate within social structure. In doing so, they utilise properties of this structure and can subsequently transform or reproduce this structure. Does this sound familiar? Take for example someone

mapping social and economic statistics in a local authority. They take from their surrounding network of relations, e.g. how maps work (e.g. OS), the data available (e.g. WG, ONS), and the software (ESRI, MapInfo). Through this then they can instigate change.

Within structuration then, there is a need to consider how to conceptualise structure; agents who use structure and the ways in which they are mutually implicated within each other to produce varying patterns of human organisation.

According to Giddens, structure can be conceived of consisting of 'rules' and 'resources'. Rules are the generalizable procedures that actors use in various circumstances. Mapping, for example, has developed rules. Some of these rules are normative in that actors can articulate and make reference to them but others guide the flow of interaction in ways that are not easily expressed or verbalised. Moreover, these rules can be transformed in to new combinations as a result of interaction. Resources are what actors use to get things done. Therefore, a map could be a resource for a policy maker, whereas, a geographic boundary or social or economic dataset may be a resource for someone mapping for policy making. Resources provide the capacity to perform tasks according to rules. This is where power rests and can be mobilized through the enactment of resources to shape the action of others. Rules and resources hence tie social relations together. Therefore, they can lace together many aspects of social relations in time and space. They are also subject to change because of their many diverse combinations.

These rules and resources can be classified in accordance to their detail. Giddens suggest a typology of domination, legitimization and signification. This is important in terms of mapping rural statistics. Resources are for domination as they utilise material and organisational resources to get things done. The problem is that a map is resource but so too is its constituent parts. Both are subject power games within a political context.

Rules can be used to define what is normal both in terms of a map and in terms of what should be displayed within it. Therefore, these rules count what is legitimate. Unconventional methods of representing rural social and economic GI can therefore be easily dismissed compared to more normative maps. Interpretive rules can also be used to create meaningful symbolic systems and this is more linked to communication. Despite being somewhat restricted by the resources available (e.g. data boundaries, software, training), they offer a means to see and interpret events.

This stock of knowledge and interpretive schemes can come from outside policy making (e.g. semiotics) or from within (e.g. institutional best practice) and make it possible for actors to communicate and construct policy facts using maps.

Importantly, active agents, in accordance with the fundamental principles of organisation, can use rules and resources. This means that the concepts of structuration theory can be applied as a sensitising device within different scenarios. This is useful as it means the concepts within this research can be articulated at different points in time and within different societies according to how rules and resources are mediated prioritized.

Empirical evidence within this thesis focussed on the actions of agents as they describe their experiences of mapping social and economic statistics for rural Wales. According to Giddens, structure as a duality is something that is part of the actions of agents. Therefore, understanding the context and the individual is important. Agency, according to Giddens, is the event in which an actor performs. It is what the person does in a circumstance that has visible consequences (these may not be intended).

The dynamics of agency are important in terms of understanding the differences in mapping practices found within the same institution covering the same space. According to Giddens, both unconscious factors (e.g. a motivation to sustain ontological security) play a part as well as the stock of knowledge that individual has accumulated (e.g. experience or rural places or education and training in mapping, knowledge of policy issues) and a justification for action relative to the action of others and to reflexively assess the consequences of actions.

Routinisation and Regionilsation of interaction amongst actors help shape how structure and agency interact in time and space. Routinisation therefore helps to explain why some elements of mapping endure over time and warrant the trust of agents. This was found in Carmarthenshire, for example, where a role changed and the new member of staff began mapping just because it had always been done.

Regionalization can help to explain the difference between institutions in Wales through what Giddens terms the regionalisation of interaction through a *locale*. This goes some way to explain the different organisational cultures in relation to mapping.

However, it has been found in this thesis that mapping is increasingly being used outside the context of a locale and acting at a distance through the Internet. This,

therefore, somewhat collapses the time-space dimension and a loss of the local stock of knowledge and interaction associated with mapping. Mapping is now acting at a distance. It is here, if anywhere, where ANT can be used to investigate the network of associations. Alternatively, as specific locale can be created within which collaborative mapping can occur. Creating a place for communicative action could offer another alternative that would rest more comfortably as a methodological framework for mapping rural statistics within structuration theory.

Examples of Correspondence - Initial Contact

Dear Sir / Madam.

Working as a research associate at Cardiff University has developed my interest in rural policy making, particularly in how visual representations, such as maps, are utilised during the process. In my spare time I am a PhD student and my thesis is – (insert thesis title).

My research aims to discover how digital technologies (such as GIS and online mapping facilities) are shaping the way social and economic data (such as household demographics, unemployment, etc.) are represented and displayed for sparse areas. I will be using Wales as a case study to explore how different types of visual representations are incorporated when it comes to making decisions.

I would be very interested in discussing my research with you and any other relevant colleagues within your authority to develop local perspectives on this matter. I would organise the discussion around the following broad themes: Roles within organisation and previous experience, data use (e.g. the type of datasets used as evidence), software, technology and methods (e.g. maps, internet based GIS systems and web based portals), and working examples where visual methods have informed policy decisions.

Would it be possible to arrange a date in your diary to discuss these topics?

Regards

Jon

Examples of Correspondence - Follow on Contact

RE: Mapping social and economic statistics for rural Wales

Good morning,

I contacted you in (INSERT DATE) to discuss, in general terms, how you and other

members of (INSERT ORG) employ statistical maps for policy making. The

information you provided during our discussion was very useful and relevant for my

research.

Following our discussion I have spoken to a number of additional

(ORGANISATIONS) in Wales. In so doing, I have developed an understanding of the

type and forms of mapping commonly used for policy making in Wales and many of

the issues linked to mapping social statistics.

I am now hoping to take the project a stage further; firstly, I would like to focus in

detail on a good example of the application of maps to explore and present social

statistics for (INSERT ORG), and discuss how this nests within policy making. I hope

to use this example to speak to as many people as possible involved in the map

lifecycle from conception to application. Do you have any good examples and would

you be able to help me construct a list of potential contacts?

Secondly, now that the data from the Census 2011 is in the public domain, I was

hoping to discuss any new social mapping projects that you or colleagues have

undertaken using this data.

My office is in Cardiff so it might be useful to discuss this at first over the phone some

time next week. I think it might then be useful however for me to see you in person,

especially if I need to talk to several other people.

Would you be able to help, or if not, perhaps you could point me in the right direction

and I will go from there?

Regards,

Jon

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Appendix D - Pilot Interview Schedule

Data Unit - Pilot

Introduction

Interested in how social and economic data can be visualized for rural areas and I am looking at the public sector bodies as the research involves investigating how this can affect policy making.

I previously met XXXX with Dr. Scott Orford at Cardiff University and we discussed broadly the developments of the Data Unit in terms of InfoBase Cymru and the associated local systems. This interview is to elaborate on some of the themes from this meeting and see if there was anything we missed.

Are you happy for this interview to be recorded?

Personal Information

 Confirm Interviewee name, describe role in organization, previous experience of using visualization

Current Data Situation in Wales for Policy Making (Moved to Distributed GIS)

- How was data visualized before InfoBaseCymru?
- o Who has/has not collaborated with the project?
- How is the situation in Wales different to other regions (e.g. England, Scotland)?
- o What did you mean by developing a 'Welsh Approach' for small area levels
- Who are the intended end users? (Public/Voluntary Organizations, Policy officers, but no so much Research and academics-why)?
- o Do you have any statistical information on this, surveys, log in details

InfoBaseCymru & Software

- Purpose of InfoBaseCymru
- o How InfoBaseCymru was developed and funded?
- Software (why Instant Atlas?)
- Specific techniques or ways of representing statistics used /not used (e.g. cartograms)?

Local InfoBase & Rural Needs

- o Purpose of local InfoBase?
- o Key differences between local InfoBase and InfoBaseCymru
- $\circ\ \ \,$ To what extent can do the local InfoBase systems need to be similar?

- Who controls what is shown externally (to public) and what is available internally ("~60% internal for local areas")
- o Who has access internally?
- Is it capable of addressing rural issues, how? Different approaches taken by urban and rural Local Authorities
- Are there problems with larger areas such as Powys as its area is most of Wales?

Examples

Can you provide some examples of how InfoBase has been used

Data & Representation

- Types of themes (data sets) used /not used?
- Why are certain scales of analysis used? Different boundaries used by different LA is this an issue?
- Who decides what data, and why is it represented in certain ways (is it policy, software, understandable by LA)
- "Aimed to meet 70% of your needs" what is lacking with INFOBASE systems (the 30%)?
- Problems Issues concerning number (low numbers in sparse locations), Area (misleading views), Symbolization, data availability, other issues?
- Ecological Fallacy and MAUP
- Levels of interaction, Public/Private distinction, Visual thinking or Visual communication?
- Training (given to one person on behalf of LA and it is their responsibility to disseminate, or guidelines given to all in LA, is there a preferred method of using the software set out by the Data Unit?

Future Plans

- o Feedback mechanisms?
- How do you assess if a visual representation of data is suitable/needs to be improved?
- o Have you plans to use other types of visualization in the future?
- Ensuring the adaptability of INFOBASE systems to current trends?
- Foresee any problems using visualization in the future?

INTERVIEW QUESTIONS - LA/WG

General Information and background

- Confirm Names
- Describe role in organization

Traditional methods of displaying data for policy and current software and techniques

- ➤ How do you define rural (at your organisation)?
- What types of data do you collect?
- Are any of these data specifically rural?

Integrated systems

- What software / systems do you currently use to manage and visualise (rural) data
- Are you aware of any recent technological changes in the way (rural) information is communicated
 - Has this changed the way (rural) information is communicated in your organization
- ➤ InfoBaseCymru who uses it what are your views
- ➤ Local InfoBase who uses it what are your views
- Collaborations for data sharing

Have you ever seen or used any of the following (show examples).

- Please comment on them.
- > Any other examples?

Spatial levels: National, Local and acknowledging rural (moving towards a local approach?)

- > How does you rural data fit with mainstream policy concerns
- Do you use visual methods to think about the data or to communicate information or both
- How does rural data move from exploration and analysis stages (i.e. in-house use of the data) to a final presentation stage (sharing the data with stakeholders)
- ➤ How do you share (rural) information within your organization
- ➤ How do you share (rural) information with other stakeholders? Please comment on the following:
 - o Forestry Commission
 - Environment Agency
 - o WAG
 - o Police
 - o Health
 - Local Service Boards
- How do you bring in local (community) knowledge?

Rural data and representation (issues?)

- Who uses rural information?
- ➤ What are the current policy issues in your area that require rural data how is rural data used?
- Could you provide any working examples of how rural data has been utilised and resulted in a policy decisions
- > Are there any difficulties that you have encountered when attempting to work with rural data
- > Do you have displaying the data because of low population levels, unequal area, symbolisation
- How do you account for the MAUP and the Ecological Fallacy (these terms need elaborating)

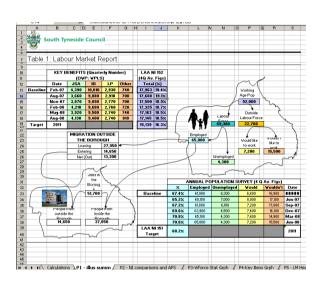
Future Plans

- How useful do you consider current methods for visualizing rural data?
- What feedback mechanism in place to judge the success of visual representation of (rural) data
- Can you foresee any problems in the future related to visually representing rural data?
- > Any other comments?

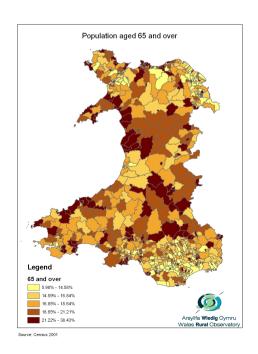
Contacts

- Are you aware of any other people it would be useful for me to speak to about this matter?
- > Name, Organization, e-mail, telephone

1) Excel Tools:



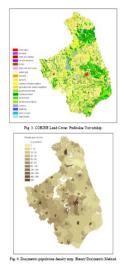
2) Choropleth Mapping:



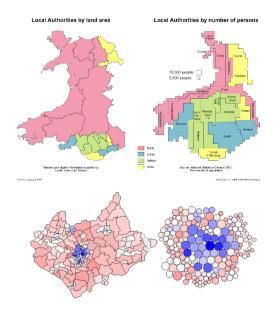
3) Dasymetric Mapping:



Figure 8: An example of the 1:50000 raster map data (left) in which buildings are displayed as the bisque colour, and the dasymetric mask (right) obtained after raster processing operations have been applied.

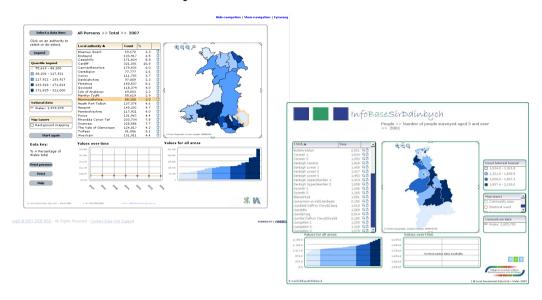


4) Cartograms:





5) Internet Mapping: InfoBaseCymru and Local InfoBase



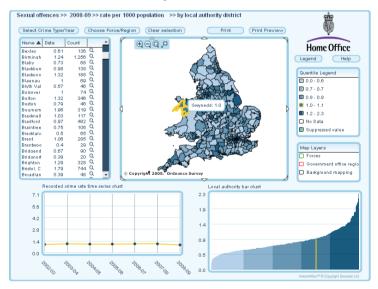
5a) National Police Improvement Agency: Local Crime Mapping



5b) Environment Agency: What's in my backyard?



5c) Home Office: Research Development and Statistics



5d) Forestry Commission: Explore, Experience, Enjoy



6) Google Earth- Street View& Web Mash ups



7) 3D worlds and VR



Interview Guide

Explain briefly what my research topic is about

The purpose of us meeting today is to discuss how the recent release of Census data is being used within your organization with a particular focus on how maps function for representing social and economic statistics policy making.

If new respondent start at 2)

1) Longitudinal interviewees

Last time we spoke you were using GIS to produce maps, has this changed since we last spoke?

- Prompt (InfoBase, Census, structural changes within organization, evidence requirement)
- If change probe for issues

Have you noticed any new technology or techniques available to produce maps or explore data? Probe InfoBase, ONS, and New software

Has any guidance been produced that you are aware of for mapping statistics?

What about GUIDANCE FOR REPRESENTING RURAL STATISTICS?

2) Census

Is the Census useful for the work you do? Why?

Do you think it is useful to have sub LA data such as that available in the Census? Why?

How important do you think small-scale data (such as the Census) is to the functioning of your organization? and in Wales more generally?

Has the Census release caused you to change the way you work?

E.g. use evidence for policy decisions? - more exploration, or more data gathering?

Is it important to be able to visually represent small-scale data such as in the Census? Why?

How important is mapping Census data for policy making? Why?

Can you give some examples of the policy areas that use mapping and Census data? Does this change between Census years?

Using the Census data do you produce social and economic statistics for-rural areas? If yes, do you map these in a particular way? If not, why not?

3) Example of the map-making process

Can you provide a specific example of how social or economic statistics have been mapped and used within a policy process?

- How does the problem arise?
- How is the decision to use a map negotiated
- Are there ever any discussions as to what should be shown or how to show it?
- What data sources, where, why?
- What guidance/ expertise are used
- Who else is involved other than the mapmaker?
- Who has authority in terms of what is shown?
- How many internal circulations/revisions?
- Who decides when the map can be signed off and is finished
- Who then uses the map?
- What was the purpose of the map?
- How did it fulfill this purpose?
- What impact can the use of maps have for making decisions, promoting an idea, having 'real world' action?

What do you consider the benefits of creating maps? What do you consider to be the difficulties?

4) Mapping roles

Are you involved in mapping data for policy purposes?

Does the release of Census data affect the way you map information?

Who else is involved in mapping Census data? Do you collaborate?

Are there standards for mapping data or guidelines? Training?

Are there people within the council who do not use maps? Who? Why?

5) InfoBase

Are you familiar with the InfoBaseCymru and their local derivatives?

What role do you think InfoBase plays in the work that you do? within your organization?

Are they useful systems for collaboration?

What role do you see these systems playing in the future?

Appendix H Interview Guide Phase 2 (Snowball Interviews)

(INSERT CONNECTION TO MAP)

Organization - Business Support
Senior Manager – [NAME]

XXXXX

[DATE] at The Beacon [TIME]

http://www.beacon-enterprise.co.uk

The Beacon - Centre for Enterprise

Dafen, Llanelli, Carmarthenshire SA14 8LQ

01554 748800

Research Background:

I have been investigating how rural statistics are visualized for policy-making purposes and have used Wales as a case study.

Been developing a picture of the current state of play looking at issues and examples of good practice. I have also been looking at the InfoBaseCymru and Local InfoBase systems and how these new technologies are being utilized and how they compare to existing practices. So far I have spoken to a number of key individuals working with statistics in local authority councils and the Welsh Government. I have also spoken to several people from the Data Unit Wales.

The purpose of this discussion today is to discover how you have been using maps and other representations of statistics in practice.

Interview Outline

General Information and background

- Confirm Names and role
- > Describe the typical day-to-day activities you undertake in your role
- > How do you contribute to policy making?

What is your spatial remit?

What type of information do you require to guide you in your role?

Have recent public sector changes affected the way you use statistics?

Do you account for population sparsity (or rurality) in your role? If so how? If not, why not?

In terms of the work that you do here for this organization, do you have the capacity to produce your own visual representations of statistical social and economic data? If so, explain. If not, why not?

Are you aware of any support, advice or training in visually representing statistics?

Now some questions about the JSA claimant count update that I understand you receive:

- How did you become aware that this information was available?
- Which policy area does the data fulfill?
- ➤ How long have you been using these updates? How often are they used?
- Do you use all the information in the document or do you concentrate on a particular aspect?
- How does this document add to what you already know about Carmarthenshire?
- > Do you share the information from this document with others?
 - o Who? How?

Now I would like to focus on the visual aspects of the document such as the maps (SHOW PRINTOUT).

- Which representation do you find most useful?
 - o Which map do you find most useful?
 - o How do you use the tables?
- Could you describe what you think each representation is showing? (Ask to think out loud)
 - The selection of data shown
 - The use of titles
 - The use of spatial boundaries
 - The key to the map (and the breaks in the data)
 - o The colour scheme used
 - o Diagram annotation
 - o Comparability with other information in the document
- How do you think the statistical representations (maps) could be improved?
- Have you provided the map producer any feedback? Explain
- > How dependent are you on this type of evidence?

Could you provide a working example of how you have used the maps from these updates in practice?

> Another example?

Additional uses of mapping

Do you have any other examples of how you have used mapping?

Since the release of Census 2011 data there has been an influx of detailed spatial information available for use in policy.

- ➤ How important is Census data for policy making?
- ➤ How important do you think it is to map this type of information?
- ➤ Have you used this information? How? Maps?

Are you aware of InfoBase systems house by the Data Unit Wales? Probe

The Regional Learning & Skills Observatory for the South West? Probe

What do you consider to be the most useful form of statistical representation for policy making?

How useful do you consider current methods for visualizing statistics that cover rural areas?

Future Plans

- > Looking to the future what are your plans over the next ten years?
- > Do you foresee any changes to the way the organization uses statistics for policy making?
- Any other issues or comments you would like to discuss?

Contacts

- Are you aware of any other people it would be useful for me to speak to about the types of issues we have discussed?
- > Name, Organization, e-mail, telephone

NOTES

Organisation Name

DATE, VENUE, TIME

Key staff

NAME - Role, NAME - Role, etc.

Research Background:

Put simply I have been investigating how mapping has been used for policy-making purposes and have used Wales as a case study to look at how this might effect how rural statistics are visualized.

Been developing a picture of the current state of play looking at issues and examples of good practice. I have also been looking at the InfoBase systems and how these new technologies are being utilized and how they compare to existing practices. So far I have spoken to a number of key individuals working with statistics in local authority councils and the Welsh Government. I have also spoken to several people from the Data Unit Wales.

The purpose of this discussion today is to hear about how you have been using maps and other representations of statistics in practice.

Interview Outline

General Information

Confirm Names, Background & Describe the typical day-to-day activities you undertake in your role

RSLP Background

Could you tell me how the RSLP was formed? Funding? Who is the audience?

How does the RSLP contribute to policy making? Why do you focus on just learning and skills (ESF?)?

Could you describe your data sharing relationship with partner organizations?

How does the RSLP align with the work of Locals Service Boards?

Who decides

- the overall strategic direction of the Observatory?
- · spatial remit? How was this decided?
- · datasets are used
- spatial boundaries should be used to map statistics
- type of mapping techniques used and the style of the map

Are you aware of any support, advice or training in visually representing statistics?

In terms of the work that you do here for this organization, do you have the capacity to produce your own visual representations of statistical social and economic data? If so, explain. If not, why not?

Could you tell me briefly about the techniques/methods that you have used to visually represent statistics?

Do you provide any guidelines, training or advice for visually representing statistics?

Do you account for population sparsity (or issues of rurality) at the RSLP when representing statistics? If so how? If not, why not?

Has the RSLP been affected by recent public sector changes? Has it affected the way you use statistics?

Collaboration

How do you see the RLP observatory fitting with other existing statistical portals? For example Stats Wales, ONS

Can your provide examples of how partners within the RLP have worked together on policy problems using the observatory

Has there been any problems mapping statistics because of competing interests of partners?

Are any maps or data sets restricted to only certain members?

Have you had to deal with any issues regarding small population samples?

InfoBase systems

What have you found to be the benefits of using interactive online mapping?

What are the drawbacks /weaknesses?

Do the InfoBase systems have the potential for

- Incorporating other data (social survey data, satellite images, service locations, place names)
- Graphically representing statistics in other ways than statistical maps and graphs (e.g. cartograms)?
- Display tables and maps that highlight specific rural issues?

Do you think the introduction of InfoBase systems has changed the way policy makers are using statistics for policymaking?

Have you received any feedback or do you have any evidence or examples of how observatory is being used to map social and economic data by policy makers? e.g. to prepare funding bids?

Datasets and maps

Have you had any requests to produce custom tables or bespoke maps?

What datasets do you consider key for the observatory to inform policy making?

Are there any difficulties in representing these visually?

What spatial boundaries are used to map statistics? Why these?

Importance of Census 2011 for the work that you do at the RLP?

- o How important do you think it is to map this information?
- Has anyone come to you for advice about using the Census data?

Future

- Looking to the future what are your plans for the RLP over the next ten years?
- Do you foresee any changes to the way the organization uses statistics for policy making?
- What do you think could be done to improve the way rural statistics are visually represented for policy making?

• Any other issues or comments you would like to discuss?

Contacts

- Are you aware of any other people it would be useful for me to speak to about the types of issues we have discussed?
- Name, Organization, e-mail, telephone

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Interview Schedule - InfoBase (Longitudinal)

Names and Roles:

Background:

I have been investigating how rural statistics are visualized for policy-making purposes and have used Wales as a Case study.

Been developing a picture of the current state of play and some of the issues and difficulties. I have also been looking at the InfoBaseCymru and Local InfoBase systems and how these new technologies are being utilized and how they compare to existing practices. So far I have spoken to a number of key individuals working with statistics in local authority councils and the Welsh Government.

The purpose of this discussion today is to catch up really and discuss how things have progressed over the last few years. When we first met the local InfoBase systems were in their infancy and I would like to know what developments have been made.

Another reason is that with the release of Census 2011 data there has been an influx of detailed spatial information available for use in policy and I would like to discuss what you have done in terms of presenting this information.

Last time ...

- Explained how you chose Geowise and the InfoBase systems and spoke of their bilingual upgrade plan and its ability to function as a distributed GIS system.
- Work had been done to agree consistent data set for local authorities and the public sector could all use so there was a standardized data sets.
- Described how local systems were only a year old and some were piloted in LA and for LSBs but may not continue because of resources.

- Described how you were focusing on two geographies LA and LSOA but providing scope for local bespoke boundaries to be added.
- Some bespoke work conducted that was password protected
- Systems had scope to be customized locally
- Mentioned key audience being the less experienced map user and software was designed to be intuitive – were avoiding things such as cartograms as it might put off the target audience.
- Talked about the challenge of keeping the data updated
- Talked about how you were in the process of raising awareness

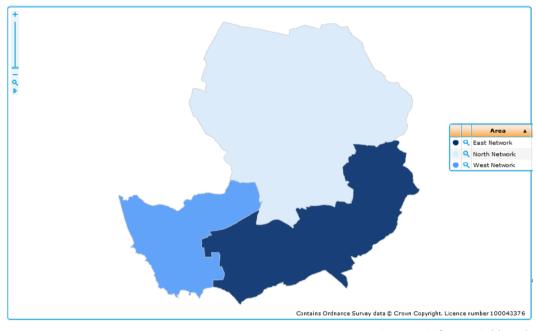
Question areas

- So first of all could you describe what has been happening here at the Data Unit since we last spoke in 2010 with regard to the InfoBase systems?
 - Software
 - Datasets/Geographical boundaries
 - o Same Staff
 - o Techniques/methods?
 - Awareness
 - Talk about the pilots and why some no longer exist (Anglesey.
 Flintshire, Conwy, Vale, Bridgend, Learning and Skills Observatory for south west, north Wales Economic Observatory, [Wales migration partnership]/ Caerphilly, Powys, Denbighshire, Newport)
- Who decides the overall strategic direction of the InfoBase systems in Wales?
 - Who decides what datasets are used
 - Who decides what spatial boundaries to map
 - Who suggests the type of mapping techniques used
- Do you follow or have you produced any guidelines for visually representing statistics?
 - o Rural?
 - Do you provide any other forms of training or advice for those wishing to map their data?
- The Census 2011 data has been released since we last spoke could you explain
 - o Importance of Census data for policy making?
 - o Importance of mapping this data?
 - o Has your workload changed because of it?
 - Has there been noticeable change in requests / traffic / enquires because of it?
 - So do you provide advice and training? to who?
 - Have you been involved or will be involved in dissemination strategies? How?

- Have you been involved in the Beyond 2011 Census debates / discussions / consultancy
- o How they see the data landscape changing over the next 2-5 years?
- How the public sector spending cuts have affected business / data needs (may have made a positive difference if LAs can save money by outsourcing there mapping services to the DU)
- Have you been involved in the new WG National Survey for Wales or other welsh data initiatives?
- The INSPIRE directive has also come into play. Have you implemented it? How has it been implemented?
 - o Has anyone come to you for advice on related issues?
 - o Do you provide training?
- Are there any other significant events or policy changes that you have been involved in or know about that might effect statistics and mapping?
- Could you explain how organizational structures in the data landscape have changed recently?
 - o Has this led to any changes to the way data is visually presented?
- Have you received any feedback or do you have any evidence/examples of how InfoBase systems are being used to map social and economic data for policy making?
- Do you think the introduction of InfoBase systems has changed the way policy makers are using statistics for making decisions?
- Do the InfoBase systems have the potential for
 - Incorporating other data (social survey data, satellite images, service locations, place names)
 - o Graphically representing statistics in other ways (e.g. cartograms)?
 - Display tables and maps specifically for rural Wales?
- How do you see InfoBase systems fitting with other existing statistical portals? For example Stats Wales, ONS
- How do you see these InfoBase systems operating in relation to Desktop GIS used in WG and LA for mapping?
- Have you any plans to include a 'rural' category in the InfoBase systems?
 Tables, Maps
- Looking to the future what are your plans for the InfoBase Systems over the next ten years?

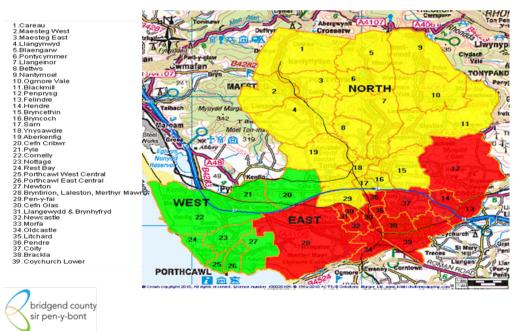
| • | I am looking to speak to as many contacts as possible now that the Census has been released please could you provide a list of people and their contact details? | |
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Comparison of Neighbourhood network maps, Bridgend Map 2: Bridgend County Neighbourhood Networks

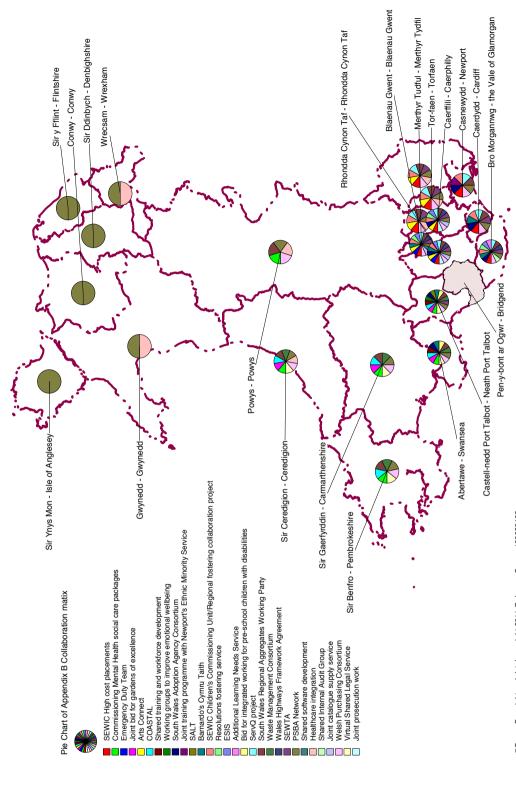


Source: InfoBase Bridgend

Map of NHN areas



Appendix A Collaboration Mapped Geographically by Welsh Local Authorities



Corporate Mapping - Carmarthenshire

Similar to many other LAs in Wales, ⁶² Carmarthenshire had a corporate GIS in place. An interview was conducted with the GIS team expert. This person was currently involved in not only the corporate GIS system but also responsible for the running of the public facing website interface called Plan Access.

"there is only two of us really who are in charge of all the GIS data sent and then other officers in the council then draw upon your data"

This role had been in place for around twenty years (since 1994) and currently involved the daily running of the system (both vector and raster mapping) and providing general support for anyone who requires mapping services or data. This included printing support,

"we have got a large printer so we can print out size A0 maps, that is if they prefer it. A lot of people prefer PDF or something like that or digital image, we just create a PDF from the mapping."

There were around 60 MapInfo licenses available within the local authority. It appeared that several departments would incorporate the centrally held GI

"They are all based around different sections so they do their own mapping"

In total <1% of staff had direct access to GIS. However most departments required, data for planning purposes that did not directly account for the social and economic characteristics of the population. An example was provided of how there was a requirement to digitize recycling routes for the planning and highways department,

"the recycling routes, they have an issue with bin collections in the authority. So there have been over that so they are trying to improve bin collections...'

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⁶² But not all for example an interviewee in Isle of Anglesey Council explained that they were the only person responsible for GIS. The scale and size of the coperate GIS teams also varied between organisation.

The interviewee described that statistical mapping did not form part of their role; instead it involved creating a platform of data and assistance to enable officers throughout the local authority to statistically map themselves if needed.

"if somebody wanted that and they were able to do it themselves we would just provide them with the information and then they would do the analysis."

Therefore there appeared to be a core set of data required for the LA and value added data that responded to the needs of each department who in turn had to manipulate the GI to respond to operational and policy issues.

There was an inward and outward facing component to the GI held by the local authority. The internal system 'saves everyone from having expensive mapping systems' and is mainly used for sharing planning applications. The outward public facing system responds to the modernizing government agenda and also was suggested as freeing up time in terms of responding to public mapping requests. The external; facing web mapping was described as, 'really old, which is why we are developing them'. These maps displayed where facilities were relative to households and selected planning areas, all displayed relative to an OS backdrop.

This type of mapping then was mainly concerned with the display of data collections, and the integration of locally produced datasets, therefore less engaged in the applied uses of maps but supportive of those who were. This highlights however that there is clear disjoint between data provision and the practical uses of the data. There is an intervening stage. Those who require the data may not be aware of the types of data available to them and the types of analysis that is possible using GIS, whereas those in a role of providing data may not be directly aware of the needs in practice or the types of analysis required to exploit the GI.

Token Mapping - Carmarthenshire

The term token mapping has been used in this instance to refer to the lifecycle of the map after its components have already been aligned together; the map is in a final format. The technical aspects of mapping have been determined and the spatial GI has already been linked to the social or economic data. It is up to the end user to tailor the maps to meet their needs, be it for a presentation or a policy report or representation within their own website. Maps are presented and made to do work.

Maps are often very similar in underlying spatial content but put to a myriad of uses. Despite similar underlying data it is rare to see two identical thematic maps produced by different organizations⁶³ although background base maps are often the same. The full extent to which this takes place is beyond the scope of this thesis, however in terms of rural statistics there are several examples where multiple views of the same underlying data are evident: the WIMD and Objective 1 areas, the ONS urban rural classification, and the Rural Development Plan. These maps appear to be used in multiple ways by multiple organizations despite displaying the same information.

At this stage human computer interaction is minimal for explorative purposes and emphasis is given to the display of spatially linked data. Now that maps are presented online, and using the example of the InfoBase systems, token changes can be made to the colour scheme for aesthetic purposes and the number of class breaks can be chosen. Dynamic linking also enables elements within the map to be queried alongside additional graphical representations of the data. The main function of the map at this point appears to be communicating trends in the data.

Thematic maps produced by a research officer at Carmarthenshire Council were traced as they moved in to the domain of other users. To discover in more detail how maps do work after they leave the private desktop environment of a research officer working in a local authority an interview was conducted with a business service manger within economic development at Carmarthenshire Council. Interestingly the interview was conducted in the Beacon Centre for Enterprise in Carmarthenshire (SA14 8IQ).

"the building was built in, er, '04/'05, um, by what was then WA, prior to the moving to Welsh Government. Um, and an opportunity arose, because this was part of the, um, Technium Network, this building.

Technium is the brand name of a business scheme in Wales that supports entrepreneurial companies by providing business support resources and services and providing access to a network of contacts. The aim has been for high technology firms to commercialise university research and turn this into thousands of highly paid jobs within technology-based firms in Wales. These ambitious plans did not materialise and whilst ten Techniums were built across Wales a damning report

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⁶³ Even topographic maps vary when constructed by different organisations

revealed that it was at a massive cost to the public purse, the buildings ended up largely unoccupied and expensive to maintain (Morgan, 2013). The WG finally began to move away from the initiative in 2010 and closed six down.

"An opportunity arose, er, for us to sign a lease, which we did in November '11. Um, and at that time there was very low, er, occupation of this building, only hand three tenants in here. The Welsh Government only had three tenants in here. Um, so we done a lot of work in terms of rebranding, rebranded The Beacon Centre for Enterprise. Um, and basically we've, um, filled the site, um and, er, I can pay the bills, which is quite important for me to have the lights on, Er, which is good. Obviously there's a lot of void space here as well, but, er, it's been a terrific site for us, terrific lease to sign. And wider than that now we have got plans for a roll-out of a Beacon bursary, which is supporting young people. Because one of the key things that we need to do in the county is try and get more business starts, particularly amongst young people. Um, and we see this site here, it's an iconic building, we see the site pretty much as a hub for our entrepreneurship based activities. Um, so that's the site in a nutshell".

Clearly then in its rebranded format the Beacon required social and economic statistics to evidence the need for its continuation and where business related investment was needed. The interviewee described their role and the projects underway at the Beacon Centre,

"I have a team of, um, 30/35 staff who deliver key regional convergence projects, including Workways, which is an employability project aimed at supporting individuals who are facing multiple barriers to the workplace. And we have, um, around about 15 staff involved in that project, which is delivered on a regional level. But that's my, my staff in the county. Um, and we, to date, have delivered around about 1,700 participants through that programme. And we have got some excellent starts in terms of the outcomes, that our challenge is to get over 35% of leavers back into the workplace, and we are achieving that. Which, in comparison to a project like the Work Programme is delivering somewhere between three and five per cent at the minute".

Another aspect of the work taking place at the Beacon was the support businesses through the local investment fund (LIA).

"I also have a core business team, then, who are involved in activities based around supporting procurement, supporting account management through over 100 business supported there. Er, we provide other financial products like loan, um, we provide rural programmes as well, where we are supporting micro-business. Because obviously the rural economy is particularly important, and we have got various programmes under the rural development plan.

We have also got Sir Gâr—which is run here, which is a one-stop advice service to anybody who requires support on voluntary training, education, apprenticeship or full-time employment, they are based here. And then I have got the roll-out of a couple of key sites, like this one here, at the Beacon, er, where I was given the challenge, really, of making sure that this could, you know, work and really commercially operate properly".

The interviewee was focused on tackling the economic issues of Carmarthenshire and appears reliant on key performance indicators to track progress.

"First of all it's understanding the needs of local businesses. So we undertake, um, market intelligence, we undertake survey work of, we have 100 account-managed businesses that we work with. And what I mean by that is we are speaking to them at least once a quarter on their needs, okay. So it could be expansions that, you know, investments, issues on skills, um, issues on internationalisation, exporting, um, whatever it may be, um, we can capture that information and that can drive forward, For example, the local investment fund project at the moment".

This survey work was not necessarily mapped but this information was matched with existing mapped indicators to judge performance of existing initiatives that had been set in place via the Beacon. This was where there was overlap with the maps produced by the officer in Carmarthenshire Council.

"Now, going forward to that, um, we've currently got underway a LIF evaluation. And I've got a meeting later, later this afternoon on, um, where we will evaluate the success of, you know, what were the key project indicators in, in terms of creating jobs, sustaining job levels, um, levering investment into those businesses and so forth. And that will lead us, hopefully, to a new grant programme running post, er, post convergence".

It seems therefore that evidencing business needs in relation to social and economic data is a key part of the motoring and evaluation process and enables resources to be targeted and can act as a mechanism for capturing future funding.

The interviewee explained how this required the coupling of expertise and introduced a second interviewee who defined their role as a business development officer who worked under the direction of the first interviewee.

"I suppose I am here because I have been known to write bids, which I, I wrote the 19 and a half million bid, European bid, for the LIF grant so for that we have to throw in statistics as part of the bid, yeah'

This interviewee was more involved with the use of evidence to promote the social and economic needs of Carmarthenshire at least in terms of the economy and was described by the business service manager as "the glue that keeps me together".

This interviewee described how there had been a change in the way evidence was required to be used

"I don't think it's been so onerous a task in the past, when we have writing bids, to be perfectly honest. But I think the way forward, everything is now it has to be more, er, based on evidence, I mean, so with the new convergence funding"

Both interviewees discussed how there was a need to mix anecdotal evidence with survey data as well as evidence from NOMIS and the Wales Annual Business Survey.

The business services manager noted support was required to assist in this changing culture in terms of using spatial evidence,

"I think there's also a culture where we've, we, we are looking to get smarter in terms of, you know, there are times when, you know, you consider meeting if you had anecdotal evidence. And I think we, we are getting smarter now in terms of, you know, really drilling down and getting that hard intelligence through. Um, and be it through survey work, be it through the work with the, the RLP and so forth, to support us. Because one thing that's becoming clear is that there is going to be much, need for much more robust, um, business cases going forward for future funding. And there needs to be a very clear reason why, and there needs to be very

measurable, there needs to be measurable outcomes, as opposed to measureable outputs. I think is this is the big difference. A lot of former, a lot of current former programmes have been output driven. It's now going to be outcome driven, and that is a bit of a sea-change in terms of the future direction of European funded programmes"

This means that causal relationships need to be evinced and puts emphasis on the dates data are collected. The interviewee described the implications of this change in culture.

"instead of how many people you got into jobs, it will be what's your effect on the actual employment rate?

This change in culture has a number of implications in terms of rural statistics because as explained earlier there is the potential through the practice of mapping rural statistics to miss pockets of unemployment unless the data is thoroughly explored and triangulated with other ways of knowing. Regardless the implications of this drive towards discernable outcomes, for the future, are an increasing need for mapped evidence to show spatial aspects of these outcomes. Here maps can be used as persuasive tools. It seems that assistance will be required for mapping evidence.

Both interviewees had limited mapping experience themselves but explained how they tended to use maps produced by colleagues within the council.

The interviewees discussed the use of JSA maps circulated by the research officer within the council (shown in Figure 6.9 and Figure 6.10)

"We, for instance, in terms of our, um, Workplace project, that I referred to earlier, we've got, um, a couple of satellite operations within that programme. Um, and it gives us an opportunity really to evidence, um, our performance really, and, and see what correlations there are with the, the overall percentage. I mean, not all of we, we are not the only, we are not going to impact solely on the JSA claimant count, but certainly it gives us a flavour of, um, where we need to be prioritising future activity, I suppose. So, for instance, if we are seeing ... and within that as well we would be aware of major closures, and so forth, that were occurring. As it happens there are a couple ongoing now. So it will give us an opportunity to direct resources into those specific settlements and secondary settlements, and so

forth, in that sense. So short to medium term within those existing programmes, I suppose, if that makes sense?"

Notice how the interviewee links local knowledge with existing map based evidence. The map is being used to support the case for a change in practice. Maps here were use to add weight to anecdotal evidence. The interviewee provided a further example about how they had been using spatial representations of social and economic data.

"We were having that discussion, for example, this morning; I was with the director of social services this morning and they were talking about some of the issues that they are currently facing in terms of, er, the care centre for instance. Er, er, and, you know, recruitment within that sector, for instance. And, um, for example, a lot of the information that's currently held is on macro-level, I guess, isn't it, in terms of, certainly GVA, and ... GDP figures and so forth. And really we were talking this morning about how we drill down to establish, um, you know, unemployment stats for, you know, Newcastle Emlyn, for instance. Or for LLandovery because they would have several agencies in that neck of the woods. So that's when I'm, in my head, referring to micro, macro. So that would be an example there of where we could, you know, support that particular sort of, um, service in terms of some of the, the sort of challenges they are facing. It may be worth just, obviously the concept, and I was talking about the hubs that have been created, perhaps as a, as a result of the activity, the mapping exercise ...

The interviewees noted how they had collaborated with the Regional Learning Partnership (RLP) as part of their work programme. They introduced a colleague who was their contact at the RLP. They deemed this person critical to further discussions because of the specialist advice they provided in terms of mapping.

The interviewee from the RLP had previously been working on what was termed 'the hub project' as described by the project manger below,

"[the interviewee] has done quite a bit of work around, um, the hubs concept in the country, where we have got five rural hubs. Um, and within that there has been, um, when I say a match, in mapping exercise, there has been an actual mapping exercise, not a virtual, but an actual one. Where they've been able to put on paper, um, services that are available within those communities, and how they are, sort of, interconnected, I guess. Um, within

that then you would have, you know, um, pubs, libraries, um, I am trying to think of, er ...

"They also map all requests for services, so if somebody has come in, the community hall has come in and asked for a grant and consultation would have gone around that before giving them a grant then, then all that is, is marked out within the hub action plan as well".

Interestingly this was the second time this interviewee had been introduced and was indicative of the small network of individuals linked to the mapping of social and economic statistics. The interviewee explained their role before moving the Regional Learning Partnership.

"I think that's where we met before, yeah, so, um, literally looking at hubs as, er, rural hubs as community hubs, sort of thing, so looking at what services work, we're doing it basically mapping. Just a basic overview so we can at least have somewhere to start then, so we know where we are first of all, I've got a baseline of that initiative. Getting it all in, in one system, all in one series of maps, and so we can say right this is what we have now, this is suitable for needs immediately, will it to be suitable for future needs, and if so how can we ensure the future needs are met. Even through getting funding via European sources, so like an appeal, or working with other partners like skills and education, FE, literally whoever we need the groups to fill in the gaps that exist".

The interviewee described how they had joined the Regional Learning Partnership (RLP). In the role the interviewee also offered support to the Beacon projects through the RLP and this role will be discussed in the next section. Regardless the future of the hubs project was however being taken forward by,

"the community manager who managers the rural, well all the hubs, the 10 hubs in the county, I think his plan is that if you get, you've got an interactive screen and at any point you can press an area and it will visually pop up how many grants they've had, how many community grants they've had, how many community halls they have got, how many business grants they've had, what support they've had...all the support, you know, er, and the bigger picture I think he's even looking at how much, er, how many bus stops they've had funded; the whole council picture funding is his bigger plan".

Therefore in all these cases it appears that the appeal of mapping was to promote local issues by making them visible to a wider policy audience. In addition maps were being used to expose service needs and match them with current levels of provision. At present this involved a juxtaposition of mapping practices split between corporate GIS systems, desktop GIS, and distributed GIS systems. It is clear that practices are beginning to align with these new distributed systems as they prepackage maps for use in policy documents. Ideal for those looking to cherry pick statistics to back their anecdotal evidence. However by doing so many of the explorative capabilities of desktop GIS have been lost. The ability to overlay datasets has been lost and the user can no longer explore more advanced spatial relationships other than what is represented through the thematic map.