THE ESRC'S REGIONAL RESEARCH LABORATORIES : AN ALTERNATIVE APPROACH TO THE NCGIA?

J.W. Shepherd[1], I. Masser[2], M. Blakemore[3] and D.W. Rhind[1]

1: Department of Geography, Birkbeck College, University of London, 7-15 Gresse Street, London W1P 1PA, UK
2 : Department of Town and Regional Planning, University of Sheffield, UK
3 : Department of Geography, University of Durham, UK

ABSTRACT

The UK Economic and Social Research Council set up a pilot set of Regional Research Laboratories (RRLs) in early 1987. Following a successful review of this initiative, new RRLs have recently been set up and funded more intensively. The objectives of the RRLs include the need to engage in GIS research and teaching but also to provide data services, to carry out applications work (often in collaboration with users) and generally to proselytise on the capabilities and opportunities afforded by the technology. All have a regional orientation but many will also have some national focus.

The RRLs thus represent a somewhat different model to that set up under NSF funding and established at Santa Barbara, Buffalo and Maine (the NCGIA). The parallels and differences between these are set out, together with the lessons learned thus far in the RRLs and ESRC's future plans. The South East Regional Research Lab (SERRL), covering an area in which lives one third of Britain's population, is used as an example to illustrate the activities of the RRLs.

INTRODUCTION

The recent growth of interest in and commitment to Geographical Information Systems has already been well documented (e.g. Andersson 1987, Chen Shu-Peng 1987, Kubo 1987, Rhind 1987, Tomlinson 1987). This reflects a wider concern with the use of spatially referenced information to monitor, understand and (in some cases) manage both the natural environment and society itself. Many observers have pointed out, however, that much more research is required if we are to make use of such tools in a routine and efficient way.

The way in which different countries have focussed their research efforts differs. The national perception of priority areas and the scale of funding involved, the institutional context, the extent of the involvement of the private sector and the emphasis upon applied (as opposed to fundamental) research all vary between the plans of those countries of which we have knowledge. Perhaps the most advanced initiatives are :

(i) the US National Centre for Geographic Information and Analysis (Abler 1987), funded by the National Science Foundation for up to eight years to the extent of $10 million,

(ii) the Dutch research consortium based on the University of Utrecht, the Technical University of Delft, the Agricultural University of Wageningen and the International Training Centre at Enschede and funded by the Netherlands Science Research Council for a four year period (Ottens 1988),

(iii) the French activities, notably the creation of the Maison de la Geographie in Montpelier which has involved the creation of a research network linking 49 research teams across France, and

(iv) the Regional Research Laboratory (RRL) programme in the UK.

The objective of this paper is to describe the background to the RRL initiative and to outline the research plans and some of the achievements to date of the Labs. This description is set in the context of other relevant developments in the UK and is illustrated by reference to the work of one of the RRLs - the South East Regional Research Lab (or SERRL). Finally, some comparisons are drawn with the US developments.

BACKGROUND TO THE RRLs

In the UK, funding for research work in universities arises from three main sources : as a component of central government's annual budget to universities (distributed through the Universities Funding Council (UFC) to individual institutions), as contract funds from research sponsors - increasingly from those in the private sector and multi-national organisations - and government funds distributed via the five Research Councils. In essence, the Research Councils and their parent body - the Advisory Board for the Research Councils - approximate to the US National Science Foundation. Thus the Agricultural and Food, the Economic and Social (ESRC), the Medical, the Natural Environment (NERC) and the Science and Engineering Research Councils all distribute money for research and for the support of post-graduate training, although the balance and total level of funding varies considerably between them. The ESRC is the smallest one, having an annual budget of about $50 million.

The ESRC's initiative in setting up the RRLs can be considered to have arisen from two main sources, one internal and the other external. The first was a long - standing recognition by ESRC itself of the need to establish a suitable infrastructure for quantitative social science research, dating from 1967 when the Data (formerly the Survey) Archive was set up at the University of Essex. The primary concern of the Archive has progressively shifted over the years and is now very much upon secondary data sets, particularly those compiled by government agencies. As a result, it is now a national, multi-disciplinary facility which acquires, archives and disseminates machine-readable data sets to social science researchers and others. Its holdings of over 3,500 data sets make it the largest data archive of its type outside North America. In its role as

'data broker', the Archive forms part of the trend towards the commodification of information (Openshaw and Goddard 1987).

The more immediate internal trigger for ESRC to launch the RRL initiative was the findings of a joint ESRC/NSF committee. This committee isolated three topics which they saw as timely and central : Geographical Information Systems (GIS), election data bases and organisational data bases. Its findings included the recommendation that "..as a matter of social science policy, ESRC and NSF should maintain as a high priority the development of data resources that are national in scope, serve multiple objectives, are replicated all the time and are of continuing relevance to the respective research communities and to national goals" (ESRC/NSF 1986, p.5). Underlying this is a recognition that substantial investment in human skills is necessary if the value of new information technology is to be maximised. Establishing 'centres of excellence' and 'well found laboratories' along the lines of what exists in the natural sciences was seen as one way of achieving this goal.

The external 'trigger' was the efforts of the government's Committee of Enquiry into the Handling of Geographic Information - even before publication of the final report (DoE 1987) of this, the Chorley Committee. The report made a strong case for additional research and education in the GIS field and urged a commitment by ESRC and NERC to these ends (see Masser 1988a and Rhind and Mounsey 1989 for interpretations of the report's effects). Thus, though the start of the trial phase of the RRLs actually anticipated the formal appearance of the report, the initiative certainly reflects prior discussions between various parties.

THE OBJECTIVES AND FORM OF THE RRLs

The RRL initiative is one of the largest programmes ever launched by the ESRC. Its general objective is to establish regional centres of excellence in the fields of data handling, data base management, spatial analysis, software development, education, training and advice.

The trial phase was set up by inviting applications for prototype RRLs; from the forty or more applications, four organisations were selected to act as RRLs for an initial 18 month period, commencing in February 1987. These initial RRLs covered the South East (Birkbeck College and the London School of Economics), the South West (University of Wales Institute of Science and Technology and the South West Regional Computer Centre, the North (Newcastle and Lancaster Universities) and Scotland (Edinburgh University). As a matter of policy, these were selected in part because of the existance of skilled staff, equipment and software within them. Funding of this pilot or test phase was modest, averaging about $36,000 per RRL. Each RRL was to use the money to demonstrate real benefits and a demonstrable demand for its skills and services. In practice, all did this by using the ESRC money to leverage larger sums (up to four times the ESRC funds in some cases) from clients, the host institution and elsewhere (Masser 1988b).

The trial phase was evaluated early in 1988 and, between March and July of that year, submissions for main phase funding were evaluated, again from around 40 organisations. All of the original four organisations survived the review but some changes were made in the light of experience : thus Lancaster was set up as a separate RRL and, in SERRL, Birkbeck assumed the lead site role although a significant degree of functional specialisation and site- specific responsibility was introduced. In addition, three other RRLs were selected : the Midlands (based on Leicester and Loughborough universities), Northern Ireland (Queens University, Belfast and the New University of Ulster) and a consortium of two universities and two local governments in Liverpool and Manchester. For this new phase, the total funding was initially $3.15m over three years but subsequently this has been raised by about an additional $450k.

The distinctive feature of the British scheme is that - unlike the American one - the regional nature of the organisation was designed in from the outset. Such an approach was not adopted simply to minimise complaints from unsuccessful applicants! It was argued that this took account of existing geographical concentrations of skills and of differences in data collection practice between the four countries making up the UK. Moreover, it took account of two other geographical factors : local variation in research needs and priorities and the virtue in having strong regional, rather than national, training and advisory facilities. The latter point meets a strong plea in the Chorley Report for improved education and training.

Over the three years from October/ November 1988, each RRL is expected to have the following main functions, though the emphasis on each function will vary between the different RRLs :

(i) Data management. To act as a centre of expertise in the management and integration of data sources, especially at the regional level and below. In addition, the RRL will act as a source of advice regarding available data sets at all levels and maintain linkages with key organisations such as the ESRC Data Archive.

(ii) Software development. The RRL will obtain and/or produce 'state of the art' software, exploit this in projects and make available documentation, advice and support to collaborating organisations where appropriate.

(iii) Spatial analysis. Methodological research in the field of GIS and related data handling areas.

(iv) Education and training. This is intended to cover both research training and professional development. Though primarily orientated towards the research community, it may also cover any other group from which there is a demand.

The model, then, of an idealised RRL is a regional centre of

technical expertise and research excellence which has strong links with its regional community. Such a centre must have the manpower to carry out both basic and applied research and development and to provide advisory and training facilities for its region. It must also have access to suitable hardware and software facilities; whilst three quarters of the RRLs already run ARC/INFO on Vax machines, gifts of equipment and software from vendors (the first from IBM UK) are proving most helpful. Beyond the regional dimension, most RRLs will be expected to achieve national distinctiveness in one or more research areas and act as a national focus for this type of social science research.

It is evident from all this that the ESRC funding alone, on average sufficient for a software person, a spatial analyst and a technical support person at each RRL will be insufficient to meet expectations. This is particularly true since the ESRC funding is strictly limited to a three year term, after which each RRL is intended to be self-sufficient in terms of funding from whatever sources may be available. ESRC's expectation, however, is that their money will again be used to leverage other funds. Assuming a leverage factor of about 2.5, this implies nearly 80 individuals funded to work in this field over the next three years plus all of the research efforts of the academic staff who are paid for out of normal UFC funds. It will be appreciated that the production of tangible products and active colloboration with 'outside' agencies is very much in the interests of both ESRC and the individual RRLs.

A CASE STUDY - THE SOUTH EAST REGIONAL RESEARCH LAB (SERRL)

SERRL's main area of operation covers the traditional South East of England and also East Anglia i.e. an area bounded by a line running roughly from the Wash via Oxford to Bornemouth on the South Coast. Though SERRL staff expect to carry out most of our work in this area (which includes a third of the national population), they also have certain national and even international involvements : for instance, Birkbeck staff are heavily involved in national matters on the next Population Census and on international collaborative work with the French (in relation to the Channel Tunnel and other topics of joint concern) and, though at a very early stage, with the US National Centre for Geographic Information and Analysis. Owing to the expertise of existing staff and accumulated experience, SERRL can claim a national role within the RRLs in regard to both topographic (e.g. Ordnance Survey) and population and planning data and problems.

The lead site in SERRL is the Geography Department at Birkbeck College; this runs Vax mini- computers and workstations, PCs and MacIntosh micros, with access via JANET (the national research computer network) to IBM and ICL mainframes and Cray supercomputers; the graphics equipment includes 'top-end' Tektronix colour terminals bought from the first ever grant given by the University Grants Committee for GIS work, as well as the usual plotters, etc. Software available includes GISs like ARC/INFO, Laserscan software, Apple 'exchangeware', experimental software from universities around the world, teaching packages like MAP2 and numerous

mapping and statistical analysis packages like GIMMS, MAPICS and MINITAB. In the other SERRL site at the London School of Economics, the Geography department has a number of MacIntosh micros and uses MAPICS on the College Vax; it is intended that they will shortly take delivery of PC ARC/INFO.

Arising out of the 'one year, one person' pilot phase, nine SERRL Working Reports were produced and disseminated by the Birkbeck College team and projects with various organisations such as British Rail were carried out. Based on this and related work, papers by Birkbeck staff appeared in five of the first six issues of the International Journal of GIS. A SERRL newsletter was also set up. In parallel with this 'awareness enhancing' activity, pre-existing data bases containing detailed population statistics and infrastructure provision (e.g. the location and type of roads and railways and the London Underground network) in the region were enhanced and linked together.

Basic research work

In many cases, we have little or no quantitative measure of how accurate are the results from the linkage together of geographical data (see, for instance, Rhind 1988); yet such linkage of separately collected data sets is the key to 'adding value' in using a GIS since combinations of the data can be used for purposes additional to those for which the initial data collection occured. Thus, though only one combination exists of two data sets, no less than 1,048,559 such combinations - not all of which are meaningfull - are available from 20 data sets describing 'objects' within the same geographical region. Since data are rarely collected (at least in the UK) on any consistent geographical basis, it is necessary to use the 'space shared' by the geographical objects (polygons such as counties or Health Districts, networks such as streets or streams or points such as geological boreholes or mail delivery points) in each data set to link the data sets together. Such a process frequently involves a process of approximation, especially when the geographical description (e.g. using a unit postcode) is inherently imprecise. Moreover, since geographical data sets are often voluminous and sometimes error- prone, the process is rarely straightforward. SERRL has formulated a modest research programme in the area of data integration problems.

If the results of data linkage are often poorly understood, their display is little better : there is little good evidence on what is an efficient (as compared to attractive) graphic depiction of data - even though maps and diagrams as well as statistical tables are normal output from GIS. Moreover, the techniques of analysis used in GIS are still crude by the standards of those of some human analysts; in particular, human experience and 'soft' or 'fuzzy' information are not readily introduced to the evaluations. Finally, we have at present only very crude ways of conversing with the machine which suggests that future GIS should be able to act on commands given in whatever language or terminology is convenient for the user, whether he is an expert in the transfer of legal titles to houses or an environmental scientist : the development of so-called Natural Languages is a high research priority. Again, SERRL

has a targeted research programme in these areas, part of which is carried out in collaboration with colleagues in other RRLs and other universities (see Rhind, Raper and Green 1989).

The SERRL approach to applied work

SERRL's approach is both pragmatic and eclectic : the method of work varies with the topic. In applied research or development, the prefered method is to work with or for other organisations since this maximises the chances of the work being useful. The operating principle is that all 'applied' work should at least 'break-even' in terms of meeting its costs. 'Profits' are sought wherever possible and all such monies go back into supporting 'core' staff and providing new equipment. In the past, this approach has provided new computers, helped to train staff on secondment (including those on the Birkbeck 'GIS apprenticeships' scheme) and also improved the data base as new information gleaned from projects is added to it. SERRL is based in a university so has a primary commitment to education and research, rather than financial gain: thus frequent use is made (with the agreement of customers) of previous work as case studies in teaching. Wherever possible, publication of such work as scientific papers has occured, usually together with staff from the customer's organisation.

A central principle is that of independence. Birkbeck forms strategic alliances with carefully chosen partners (and is in the throes of extending and formalising its range of partners) but no relationship may preclude any other strategically important one. Thus Birkbeck runs no less than five systems in-house even though ARC/INFO (for which we were the first site in Europe) is the main 'work-horse' and relationships with ESRI have been extremely close and advantageous over the years. Equally, the Birkbeck geographers now have a relationship with Apple Computers for development of certain GIS teaching materials, as well as using equipment gifted via ESRC by IBM and other equipment purchased from DEC. The SERRL model, then, is of a way of working which normally involves other people and one in which sometimes SERRL leads and sometimes merely contributes, depending on the skills required and available.

Recent or current SERRL work

To illustrate the range and type of SERRL work, we now describe four examples of recent or current Birkbeck projects. The first of these is a study of how satellite remote sensing data from the French SPOT satellite and on-ground data derived from Local Authorities and relating to the London Green Belt, etc can be combined (Barnsley et al 1988). If created as a coherent data base, the accuracy of land use information which can be infered is greatly improved over those data produced by conventional remote sensing techniques and the range of applications is greatly extended. This project has been carried out in conjunction with planners from the County of Kent.

A second example is the consultancy study now being undertaken by Birkbeck College for the Department of the

Environment (DoE) : this is to define the needs of the Department from the next Population Census and how these could best be met. The Census data are arguably the most important single data source produced by UK government. DoE, for instance, uses it in the calculation of the funds for distribution to local government, in assessments of deprivation across the whole country and in many other research and policy matters. Results are produced in map or tabular form and the census data may need to be linked to other data sets but originating in many sources. In essence, this project involves discussions with all interested parties and the production of costed alternatives; Price Waterhouse, the international management consultants, are acting as sub-contractors to provide certain experience which is lacking in the university domain.

The third example also relates to the next Population Census, to be held in 1991. Thus far, all recent UK censuses have produced statistical tables derived from comparing the answers to different questions and summing the results for standard areas. The degree of cross-tabulation is much greater than in the US census output. As a result, around 4000 values in total were produced for each and every one of the 150,000 different standard areas for which census results are made available after the 1981 Census. Despite this detail, many users can not get the combinations of area and variables they require; on the other hand, much of the standard data is unused. The Birkbeck project, funded by the Census agencies and also by ESRC, is to explore the feasibility of an on-line computer system which would permit users to request (and receive very rapidly) precisely the results they need. The crucial requirement is that no details whatever must be divulged concerning individuals or the households in which they live - hence empirically derived rules which should ensure this constraint is met are being built in and evaluated.

Finally, by way of example, Birkbeck staff have just completed the world's first GIS tutor, called GIST (see Raper and Green 1989). This takes advantage of the Hypercard facilities, superb graphics and ease of use of the MacIntosh computer and permits individuals to explore topics such as data structures, digitising, interpretation of satellite imagery, generalisation and much else. Demonstrations may be selected by the user from the dozens available. GIST contains a searchable bibliography and much generally helpful background information on GIS, plus test questions where appropriate and a log of what the user has tackled and achieved. This will be used in all the 'hands on' portions of our short courses in GIS. To date, four such short courses have been run and all were fully subscribed though only 10% of the participants have been from academic organisations.

The integrated database

One measure of success of all of the basic and the applied research is the complexity, scale and successful use of our database, which is drawn from a multiplicity of sources (maps at different scales, government statistics for large and for small areas, etc). As the centre-piece of its activities, SERRL has the task of building, maintaining and exploiting a

spatially coherent data base of infrastructure and settlement for the whole of our region. This capitalises upon the basic research and new data sets available through project work. At present, the database occupies over 250 Mb. and consists of such features as :

- Settlement, defined by land use as urban areas and by functional importance as urban regions;

- Transport networks, including all roads, (surface and underground) railways, and some utilities;

- Administrative areas, such as Wards, Districts, Counties and Parliamentary Constituencies.

- Planning areas, including Green Belts, Areas of Outstanding Natural Beauty, Development Corporations and Sites of Special Scientific Interest.

- Demographic and household composition data drawn from the Population Census.

CONCLUSIONS

It should be obvious from the above that the RRL initiative differs in a number of ways from the NCGIA initiative, at least as originally designed by NSF :

(i) the deliberate country - wide spread of researchers in the UK regionally - based model

(ii) the much heavier emphasis on tangible products, applied work and proselytising in the UK and the open welcome given to collaboration with vendors of software and hardware

(iii) the relatively short term funding and 'sudden death' end to the UK project, after which self- sufficiency is essential.

That said, there are also many similarities between the two initiatives. The expenditure per annum is very similar. Both initiatives are essentially the products of academics and are guided and largely judged by academics ; hence the judgement of the academic community as well as ESRC on the UK project's success will be strongly influenced by new work reported in well respected journals. In this regard, the British academics might be judged to have an even more difficult task than their American counterparts. Moreover, though the regional scheme demonstrably maximises the numbers of researchers involved and - through inter-RRL competition - generates the maximum level of external support, it provides obvious dangers of duplication in work. Avoiding such duplications when up to 80 researchers are working in 8 centres in 17 institutions is exceedingly difficult and, to this end, common publications, frequent seminars and briefings, etc are planned. Our experience in the pilot phase indicates that only electronic mail makes day-to-day contacts between and even within RRLs a reality.

Finally, though all of the RRLs have been set up as an ESRC initiative, recent developments have prompted joint action by ESRC and the Natural Environment Research Council. NERC has funded a research group in the cartography/remote sensing/GIS area for 20 years (see Rhind 1988b) and today this group of about 12 staff is based in Reading University. It seems likely, however, that a joint ESRC/NERC bid for additional funding of $2 million specifically for GIS research has recently been agreed by government ; this will be jointly administered by the two research councils which also now head a joint committee of all the research councils on GIS and related topics.

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REFERENCES

Abler R. (1987) The National Science Foundation National Centre for Geographic Information and Analysis. Int. Jl. of GIS, 1, 4, 303-26.

ACA (1988) The Proposed Standard for Digital Cartographic Data. American Cartographer 15, 1, 137pp.

Andersson S. (1987) The Swedish Land Data Bank Int. Jl. of GIS, 1, 3, 253-64.

Barnsley M., Shepherd J.W. and Sun Y. (1988) Conversion and evaluation of remotely sensed imagery for town planning purposes. Proc Euro-Carto 7, ITC, Enschede, Netherlands

Chen Shu-Peng (1987) Geographical data handling and GIS in China. Int. Jl. of GIS 1, 3, 219-28.

DoE (1987) Handling Geographic Information : the report of the Committee of Enquiry headed by Lord Chorley. Her Majesty's Stationary Office, London.

ESRC/NSF (1986) Large scale data resources for the social sciences, ESRC, Swindon.

Kubo S. (1987) The development of geographical information systems in Japan. Int. Jl. of GIS 1, 3, 243-52.

Masser I. (1988a) The development of GIS in Britain : the Chorley Report in perspective. Environ. and Plan. B 15,489-94

Masser I. (1988b) The Regional Research Laboratory initiative. Int. Jl. of GIS 2, 1, 11-22.

Openshaw S. and Goddard J.B. (1987) Some implications of the

commodification of information and the emerging information economy for applied geographical analysis in the UK. Environment and Planning A, 19, 1423-40.

Ottens H.F.L. (1988) A centre of expertise for geographic information processing in the Netherlands. Paper presented at Euro-Carto 7, ITC, Enschede, Netherlands.

OS (1987) The National Transfer Format, Ordnance Survey, Southampton

Raper J.F. and Green N.P.A. (1989) GIST : an object-oriented approach to a GIS Tutor. Proc. Auto Carto 9

Rhind D.W. (1981) Geographic Information Systems in Britain. in Quantitative Geography ed. N. Wrigley and R.J. Bennett,17-35, Routledge and Kegan Paul, London.

Rhind D.W. (1987) Recent developments in Geographical Information Systems in the UK. Int. Jl. of GIS 1, 3, 229-41.

Rhind D.W. (1988) A GIS research agenda Int. Jl. of GIS 2, 1, 23-8.

Rhind D.W. (1988b) Personality as a factor in the development of a new discipline : the case of computer-assisted cartography. American Cartographer, 15, 3, 277-89.

Rhind D.W. and Mounsey H.M. (1989) The Chorley Committee and 'Handling of Geographical Information'. Environment and Planning A,

Rhind D.W., Raper J.F. and Green N.P.A. (1989) First UNIX, then UGIX. Proc. Auto Carto 9

Tomlinson R.F. (1987) Current and potential uses of geographical information systems : the North American experience. Int. Jl. of GIS 1, 3, 203-18