British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Digital Geoscience Spatial Model (DGSM) Programme 2000-2005 Report on the Mid-Term Review

DGSM Programme

Internal Report IR/05/013

BRITISH GEOLOGICAL SURVEY

DGSM PROGRAMME

INTERNAL REPORT IR/05/013

Digital Geoscience Spatial Model (DGSM) Programme 2000-2005 Report on the Mid-Term Review

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FOREWORD

The DGSM Mid-term Review Report was compiled in December 2002 for the information of the Natural Environment Research Council, the funding agency of the project. As it was not written as a BGS Internal Report, it had no natural home for its preservation. In order to achieve that, the text has been moved *verbatim* into the appropriate BGS Report template and some adjustments have been the formatting to comply with extant standards. Original versions are available from NERC.

I F Smith

DGSM Programme Manager

January 2005

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1 PROCEDURE

Prior to visiting BGS Keyworth to hear presentations and conduct interviews, the Review Panel (Appendix 1) received a number of background documents including the September 1999 Proposal to NERC (Appendix 2), the Project Scoping Study carried out within BGS in 1999 and various internal newsletters, web pages and reports. This material allowed us to have email correspondence to confirm the appropriateness of the Terms of Reference for the Review (Appendix 3) and plan for our visit to Keyworth. In Keyworth, we met for discussions on 9th October, heard presentations and conducted interviews throughout 10th October (Appendix 4) and met again, briefly, afterwards. There followed several weeks of report preparation carried out through email correspondence and occasional further requests to BGS staff for information. The Review concluded with a teleconference link to agree on conclusions and recommendations. We will be seeking an early opportunity to present the results of the Review at a meeting with the DGSM Steering Committee.

2 COMMENTS IN THE CONTEXT OF THE 1999 PROPOSAL TO NERC

2.1 The DGSM concept

The DGSM was conceived to meet "an increasing demand for an integrated, multi-dimensional approach to the provision of geoscience information for the solution of complex environmental and resource problems. The essential requirement of this approach is to represent 3-dimensional geological structures, 3-dimensional variations in rock-mass properties and (sometimes) 4-dimensional time-varying processes within a unified, internally consistent data structure." Embedded in this definition were the *development* of the underpinning information technology that would enable the BGS staff to carry out their job in the modern interdisciplinary, 3-dimensional, digital world, and the *continued rationalisation and archiving* of the very large and very diverse databases with which BGS works. The latter was to build on the BGS-geoIDS project that was already underway. The DGSM Programme started on 1st April 2000. It is now an integral part of the Core Strategic Programme and the Business Development Strategy of BGS. It goes hand-in-hand with the strategy of maximising the utility of the unique and comprehensive BGS database.

The DGSM was envisaged as having two main parts: the DGSM-F (Framework) of "databases, software applications, procedures and policies", and the DGSM-UK of "organised, systematic data for the UK, with the appropriate metadata and links to the knowledge base."

These were very ambitious objectives, and the task has proved a little more difficult than was originally thought, as will be explained in this report. However, we are satisfied that BGS is on track to deliver these objectives.

2.2 Relevance to NERC strategy

The 1999 Proposal went on to explain the relevance of the project to NERC Strategies and Priorities. In our view, these have in no way diminished with the publication of the most recent NERC Strategy document, "Science for a Sustainable Future"; indeed, the innovative approach proposed by BGS goes hand-in-hand with the modern view of environmental science outlined in the strategy document. The timeliness of the

DGSM is remarkable in this regard. We learnt that a number of attempts had been made in BGS over the previous decade to launch such a project but the technological and funding infrastructures were not quite strong enough to do it. The implementation of a matrix management structure in BGS has created an environment in which it is easier to manage a cross-discipline project like the DGSM. With the investment in DGSM by NERC at this stage, it has enabled BGS to embark on a substantial, improved contribution to the new science strategy.

2.3 The utility of the Programme

The utility of the DGSM Programme and the beneficiaries are addressed in the 1999 Proposal. At this half way stage we see no reason why the claims made in the original Proposal will not be realised. Considerable effort has been made to keep abreast of parallel developments in other institutions, including the organisation of a workshop in 2001 called "3D Geoscience Modelling"[1], and relevant developments elsewhere, including conferences and meetings in Europe[2] and the USA. It is clear that the ambitious approach taken by BGS is paying off in keeping it in step with or ahead of work in comparable institutions. We judge that BGS is among the top three institutions in the world that are taking this approach to environmental data interpretation. In fact, nothing comparable to the production line for creating 3D subsurface models set up by the BGS is seen elsewhere. Other projects, such as "GeoFrance 3D" by BRGM in France and "Hydrogeological Model Niedersachsen" by BGR/NLfB in Germany, cover only a very specific part of the production line.

However, whilst efforts have been made, there are as yet no concrete research collaborations with UK universities. Now that the technology required by the DGSM-F is close to being a working system (see below) more opportunities for collaboration will open up and should be exploited. Likewise, we see scope for collaboration with other NERC laboratories that could benefit from using a DGSM approach to their work or are using something similar to the DGSM philosophy in their modelling. For example some of the geoscience modelling performed within BAS may readily be able to benefit from DGSM technologies. Likewise many of the CEH or oceanographic laboratories (such as Proudman or Dunstaffnage), which formulate 3-dimensional models, albeit usually covering shorter timescales, may also be supported by DGSM-F protocols and structures. If NERC wishes to fertilize future collaboration between its component institutes it is important that technologies developed in different parts of the organisation, do not remain parallel, but converge.

2.4 Budget and expenditure

NERC awarded BGS £4.335m over 5 years against a bid for £4.75m. BGS planned to commit at least the same amount of support from within its Science Budget from NERC. We were told that the latter sum is between £4.8m (as indicated in the Proposal) and £11m depending on where the DGSM boundary is drawn within Science Budget work. The evidence from the breadth of, and progress in, the component sub-projects of the DGSM (Appendix 5), as well as from related projects to expedite digitisation of databases and generate 3-dimensional models, confirms a

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[1] Nottingham, 30-31 May, 2001
[2] Spa, Belgium, 7-12 July 2001, "New Paradigms for the Prediction of Subsurface Conditions"; BGR/NLfB, Hanover, 6-7 November, 2001, "Geological Modelling Aspects"

level of activity that is equivalent to expenditure at this level. We are satisfied, therefore, that BGS is meeting its side of the bargain with regard to cash and "in kind" resources for the project.

A slightly closer look at the budget reveals a shift of expenditure on the £4.335m awarded by NERC towards the development of the DGSM-F. The table compares the original funding model for DGSM-F and DGSM-UK as proposed in 1999 with actual and predicted expenditure (£k).

	Year 1 (2000-2001)	Year 2 (2001-2002)	Year 3 (2002-2003)	Year 4 (2003-2004)	Year 5 (2004-2005)
DGSM-F proposed '99	310.0	250.0	210.0	180.0	180.0
DGSM-F actual / predicted	364.8	605.3	523.9	486.5	316.5
DGSM-UK proposed '99	640.0	700.0	740.0	770.0	770.0
DGSM-UK actual / predicted	175.2	339.7	426.1	463.5	633.5
Sum awarded by NERC	540.0	945.0	945.0	945.0	945.0

The shift reflects in part the significant element of estimation that had to go into the original budget for this innovative work. In particular, it was underestimated how difficult and time-consuming it would be to establish the DGSM-F (see below). It also reflects the fact that work in progress in BGS has been more able to contribute to the DGSM-UK rather than the DGSM-F, given that several projects are already working on 3-dimensional models for different parts of the UK. Therefore, we do not see anything sinister in this shift of resources. Nevertheless, we do think that there is a lesson to be learned for costing DGSM-F-type work in the future.

We noted that apart from the core DGSM activities there is some financial support given to closely related or underpinning research within BGS. There are three areas: the SIGMA Project; digital conversion and correct formatting of some essential databases needed for testing the DGSM-F; and ensuring new projects work to DGSM standards in anticipation of full uptake of the DGSM in 2005. Overall, there is no doubt that ultimately the DGSM Programme will represent good value for the money spent on it.

2.5 Scheduling and progress

Comments on scheduling of DGSM work as outlined in the Proposal are given in the following two sections.

3 DGSM FRAMEWORK PROGRESS REPORT

3.1 Progress with setting-up the Framework

It is clear that the 1999 Proposal underestimated the complexity and demands of setting up the DGSM-F. A mere four projects in the Proposal have become twelve (Appendix 5). One of these, SIGMA, which aims to develop methods for digital data collection in the field, has, in part, been brought into DGSM-F recently because it is envisaged that the field data will be uploaded directly into the DGSM data store.

In a programme of this magnitude, that will be at the heart of BGS work practices for decades to come, it was essential for the BGS staff to know that all individual component parts would be achievable before embarking on creating any one of them. We heard that it took 6-8 months at the beginning for the Programme team to settle on definitions for the data store (now called Geoscience Spatial Framework, GSF) and the model warehouse (now called Geoscience Large Object Store, GLOS), and to conceptualise a framework that would preserve the richness of multidimensional models at the same time as provide access to their parameters for use in other projects. Creation of, and access to, the essential metadata that goes with the models and the creation of the essential data linkages to enable the framework to operate as a complete entity required considerable research and they still have crucial steps to take before being operative. Some objectives have had to be dropped for the time being because the technology is not yet available to implement them, such as the full integration of models generated by different modelling software packages (because of incompatibility between systems, missing communication interfaces). There are still fundamental aspects to resolve, such as how to measure error and uncertainty in models and how to establish links to a range of other data types. Error and uncertainty is an area in which collaboration with universities might be fruitful.

3.2 Factors affecting progress

We are happy that the DGSM team wanted to have the underpinning concepts for the Framework agreed before embarking on the selection of software packages and system building. It is noteworthy that the BGS has in-house staff with appropriate IT and geoscience expertise that are capable of undertaking such complex tasks. However, the availability of such staff has also caused problems for the DGSM, because they are in demand for projects elsewhere in BGS. Competition for their time has contributed to further slippage in the schedule of the DGSM-F. Moreover, considerable time and effort (and expenditure, as shown in the table above) will be required in years 3 and 4 of the DGSM-F projects and possibly beyond as technology is changing and improving. Realistically-costed plans for sustainability and maintenance will be needed. The Review Panel considered whether more work could have been contracted out[1], but decided that this would probably not have been a cost-effective option. Under those circumstances BGS would not have been able to build the in-house expertise that will allow the DGSM to evolve in future years.

Despite the slippage in the work schedule the DGSM Steering Group (see section on Programme Management) is confident that the DGSM-F will be complete and operational within the five-year timeframe. We were told that progress is now accelerating, and a test of the functionality of the GSF and GLOS at the heart of the

[1] Dr S Henley has been retained as a consultant to advise on key aspects of the GSF

Framework is underway using data from the Cheshire Basin Project of the DGSM-UK. An intranet data portal to the GSF data store is already operational and in use by modellers. Key elements to be tackled in the near future are the development of shareable visualisation tools, continued refinement of the GSF, continued development of data linkages, and refinement and development of modelling applications.

4 DGSM-UK PROGRESS REPORT

4.1 Status of the DGSM-UK

The concept of DGSM-UK is really a long-term one because it will take time to establish databases and models at appropriate resolutions for various parts and, ultimately, the whole of the UK. The five regional projects proposed in 1999 were intended to be pilot studies that would test the DGSM-F in various geological environments with socio-economic significance using different data types and at various resolutions. The range of regions has now been revised and extended to seven (Appendix 5): DigMap Enhancement is included here because it is essentially a digital model of UK geology, albeit a 2-dimensional one. These projects yield end products that can be stored as definitive datasets and models. Appendix 6 shows the workflow chart for the Humber Estuary project that is nearing a successful completion, providing an example of what is already possible at this stage.

4.2 Modelling software packages

Consistent with the BGS corporate strategy, ORACLE has been selected as the software for creating the DGSM databases and GOCAD[2] is the preferred 3-dimensional modelling software, although Vulcan[3], Earth Vision[4] and GSI3D[5] are all used. A comparison between these packages is difficult because they are suited to different sorts of problems, all of which BGS might address at various times. For instance, through the very small sample of work we saw in the time available to us, it seemed as though GSI3D has good functionality for stratigraphic modelling and is liked by those who use it. The project management may wish to limit the number of different incompatible models by focussing on only one or two of these software packages. However, if for functionality reasons more than one package is needed, BGS should as soon as practicable establish interfaces between them for ease of data exchange. We appreciate that this is a significant IT challenge, that it might not be a priority at this stage and that it might be best pursued with external groups, from the oil industry for example. 3D GIS is another technology development that would strengthen the DGSM but is perhaps best developed in the private sector.

4.3 Keeping the Framework and modelling in step

The way in which this part of the DGSM would develop was much easier to predict at the outset because of the experience of database creation and modelling within BGS.

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[2] www.gocad.com
[3] www.maptek.com or www.vulcan3d.com
[4] www.dgi.com/index.shtml
[5] hans-georg.sobisch@uni-koeln.de

This fact has brought some unexpected problems, however. It took little encouragement for staff working on regional geoscience problems to generate models with potential to go into the GLOS. As a result, the modelling was taking place without the appropriate DGSM protocols having been established. We are satisfied that this problem has now been corrected and the DGSM-F and –UK pilots are now proceeding hand-in-hand as originally envisaged.

5 MANAGEMENT STRUCTURES AND RELATED ISSUES

5.1 General structure

The DGSM Programme Manager is Ian Smith. There is a Programme Steering Group (Appendix 7) under the Chairmanship of Ian Jackson, BGS Director of Information Services and Management. This Group has a well-balanced membership of IT and geoscience experts with good management experience and meets six times a year. At each meeting it hears progress reports from a selection of project managers as well as discussing and deciding upon the progress and direction of the overall Programme. In 2001 Richard Shaw joined the Steering Group as Operations Manager to monitor progress more closely and enforce deadlines while Ian Smith concentrates on conceptual development and budget matters. The Steering Group advises the Programme Manager and Programme Director and the latter reports regularly to the BGS Executive Committee and formally to the BGS Board annually. This approach to management is working well.

5.2 Promoting the DGSM within BGS

During our discussions it emerged that the change to matrix management of staff and projects in BGS has been of considerable help to the DGSM Programme. It helps in two ways. Firstly, staff working on the DGSM could be recruited and drawn from other projects throughout the matrix and therefore bring a wide range of expertise and experience to the DGSM Programme. *Vice versa*, the same staff disseminate information about the DGSM to their colleagues on other projects, thus helping to raise the profile of DGSM outside the immediate Programme team.

Promoting the importance of DGSM to the wider scientific staff in BGS has been a major concern of the Programme management team. We talked to some geologists who have readily accepted the paradigm shift from map making to spatial modelling and cannot wait to use the DGSM when it is up and running. Indeed, they seemed to have been working towards a DGSM philosophy themselves for a number of years and expressed some frustration at having to wait for the new system to be "rolled out". However, after decades of working with conventional practices to produce geological maps, many staff are sceptical of the need and benefits of the DGSM. Whereas in the past staff have seen the fruits of their labours as being their own, their results will now reside in the corporate data or model stores. The management team have organised an internal roadshow, published a regular newsletter, maintained a website and regularly review their strategy to promote the Programme. It is clear there is a need to "sell" the DGSM to staff who, up to now, have not been a part of it. A user-friendly "front-end" to the software and/or the use of modelling packages that several staff are already familiar with, e.g. GSI3D, are possible ways of easing the transition. Nevertheless, we are confident that within the timeframe of this five-year start-up phase of the DGSM a situation will exist where there is little resistance to the new practices.

5.3 Staff training

The need for training follows logically from the adoption of new working practices. A Training Project is underway in which the Programme staff are being trained in the use of database and modelling software. A Best Practice Project is also underway that will assemble best practice discovered during the development of the DGSM-F and its implementation in the pilot studies of the DGSM-UK. Best Practice will inform training in the longer term.

5.4 Staffing issues

We heard several times that a major factor contributing to delays in the development of the DGSM-F is the availability of skilled IT staff. Delays in one area of the Programme can have a knock-on effect to other areas. As mentioned above, BGS has some outstanding IT talent, but these staff are in demand for other projects and there is always the danger that they will leave the Survey for better-paid jobs in industry. The issue of staff recruitment and retention is beyond the scope of this report, but we would like to pass on, or at least reinforce, the message to NERC that this is a serious problem for BGS. Although it may ease a little after the current phase of DGSM development, system maintenance and staff training will be ongoing and will require skilled IT staff.

5.5 Resource requirements

We enquired whether the computer hardware resources required by the DGSM in terms of storage and network capacity and machine size and speed are a factor affecting Programme development. A network upgrade is being planned, which will improve communications generally, but at the moment these factors are not a major concern. However, it was acknowledged, and we would like to emphasise the fact, that the demand on these facilities will grow substantially when all BGS scientific staff are using the DGSM and will have cost implications that did not exist before. Since such infrastructure items are typically funded from overhead income and capital expenditure it will be important for BGS to maximise these income streams to capitalise on the DGSM.

6 PRODUCTS

6.1 Current productivity

We learnt that it had been accepted in BGS that the diversion of significant resources to initial DGSM development would cause a temporary, small loss of geological productivity. As it happens, the Foot and Mouth Disease outbreak curtailed geological productivity for a while and so the impact of the DGSM on other work has so far been negligible. Nevertheless, this is a situation that will have to be carefully managed over the next few years.

6.2 Future productivity

The Programme is, of course, an investment for the future. At this early stage most concrete products from the Programme are a number of internal reports (Appendix 8), as would be expected. We are confident that by the end of the start-up phase BGS will be able to make maximum use of its extensive, unsurpassed databases to deliver, over the internet if required, a wide range of products from datasets and models, such as derived maps, profiles and sections, and also perspective views of 3D models. The loss of a distinction between onshore and offshore databases means that the coastline will no longer be a hindrance to the multidisciplinary solution of coastal problems. It is thought that the digital, 3-dimensional format of products will allow BGS to advertise its services more effectively, win customers and respond more flexibly to customer needs for subsurface information. It will provide the Survey with a competitive edge in bidding for contracts in the international market, for example.

There is little doubt that the IT expertise gained in establishing the DGSM will be a powerful source of knowledge within NERC and will be marketable in its own right. The breadth and depth of the expertise is probably unique in public sector institutions. The Geological Survey of Ireland has already contracted BGS to help with their database management and may be the first of many surveys to seek this kind of help.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

- The DGSM Programme represents **high-quality science and technology research** that will place BGS at the forefront of the solution of geological and environmental problems in the 21st century. It is a key, integral part of the BGS Business Strategy. It will facilitate and improve BGS's contribution to the new NERC strategy "Science for a Sustainable Future".
- **Sound Programme management** structures are in place. The DGSM Steering Committee has a balanced membership of IT and geoscience experts.
- Overall, we are satisfied that the **BGS is on track to meet the objectives** and schedule set out in the 1999 Proposal to the NERC STB, although it is vulnerable to key staff being taken off the DGSM Programme from time-to-time to work on other projects. The DGSM Framework development has proved to be a complex and more time- and resource-consuming task than originally envisaged, but progress is accelerating now that a steep learning curve has been negotiated. There are indications that existing staff expertise in 3D modelling will make the DGSM-UK a faster process, but it cannot proceed at full speed until the Framework protocols are sufficiently well established. Whilst the Framework will have absorbed more of the planned budget, the BGS is able to profitably direct some of its recurrent Science Budget (SB) income towards the DGSM-UK.
- We are confident that the **DGSM budget is being spent wisely** and the end-product will represent excellent value-for-money. A wide range of new BGS products will emerge as a result of the Programme, and new products will continue to emerge as the DGSM evolves over the following years.
- The **quality of the IT and geological staff working on the DGSM is very high**. They have become fully engaged with this bold and innovative project. There is a great demand right across BGS for the skills that these staff have and, in practice, there is a shortage of skilled IT staff in BGS. Amongst staff who are not as yet involved with DGSM work there is some scepticism as to the need for a DGSM.

The DGSM management team are putting considerable effort into promoting the DGSM to ensure its universal acceptance by the time it is “rolled out” to all staff.

- The DGSM represents a **considerable advance in maintaining and developing the capability of BGS** and brings with it a need for the resources to maintain it beyond the 5-year development and start-up period. Relevant staff training is vital, skilled IT staff will be required, relevant commercial software developments will have to be monitored and made use of, and computer workstations and networking within BGS will have to be regularly updated.

7.2 Recommendations

- Care should be taken to **nurture the excellent IT talent** that exists in BGS since such talent is in great demand elsewhere outside BGS. Efforts should be made to bring the IT staff complement up to a level where competition for their skills does not endanger projects and programmes, and pressure on their time does not disenchant existing IT staff.
- During this development phase of the DGSM renewed efforts should be made to **undertake collaborative research** with relevant academic groups that might be able to contribute to the development of the technology.
- As soon as BGS is confident it has an operational system, the scope for **collaboration with other NERC laboratories** that might be able to make use of the technology should be undertaken.
- It is essential the management team continues to **“sell” the DGSM** to sceptical staff by all means possible.
- There are technological developments that would enhance the DGSM further still, e.g. a solution to the problem of **interoperability between modelling software** packages and 3D GIS. The Programme managers might like to consider whether it is worthwhile BGS embarking on the development of these or encouraging other concerns to hasten their development. It is envisaged that, although GOCAD is the preferred modelling package, there will be a need to retain licences for a number of different packages that fulfil specific functions.
- BGS should look ahead now at the **resource requirements of the DGSM beyond 2005**. As computer hardware and software are typically funded from overhead income, infrastructure grants and capital expenditure it will be important for BGS to maximise these income streams.

APPENDIX 1 Review Panel Members

Dr Roger Scrutton FRSE (Chair)

Reader in Marine and Applied Geophysics, University of Edinburgh, BGS Board Member.

1.1.1.1.1 Dr Horst Preuss

Director and Professor at the Geological Survey of Lower Saxony, Hanover, Germany. Head of Information Systems in Applied Geology.

1.1.1.1.2 Dr John Rees

Programme Manager, Coastal Geoscience & Global Change Impacts, British Geological Survey.

Kathryn Booth (Secretary)

Central Directorate Support Group, British Geological Survey.

APPENDIX 2 Bid to the NERC ESTB Thematic Programme

DEVELOPMENT OF DGSM-UK 24 SEPT 1999

The Development of the Digital Geoscience Spatial Model for the United Kingdom

CONTACT

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1 BACKGROUND

The Digital Geoscience Spatial Model of the UK will represent the onshore and offshore geology of the UK as a series of consistent digital three-dimensional models at various resolutions. It will provide the underpinning basis for all two- and three-dimensional visualisations of structures and rock-mass properties, as well as for research into geoscientific processes across all disciplines.

There is an increasing demand for an integrated, multi-dimensional approach to the provision of geoscience information for the solution of complex environmental and resource problems. The essential requirement of this approach is to represent 3-dimensional geological structures, 3-dimensional variations in rock-mass properties and (sometimes) 4-dimensional time-varying processes, within a unified, internally consistent data structure.

Traditionally, the British Geological Survey (BGS) has made its geoscience knowledge available to the user-community as maps and books. Modern Information Technology allows 2-dimensional maps to be replaced by 3-dimensional digital models as the central reference source on UK geoscience. Models can be readily amended and revised to accommodate the latest observations, in contrast to the infrequent revision and publication of maps. They will be internally consistent for the whole UK landmass and offshore area and will provide access to the vast range of information on which they are based, previously available only as paper reports, memoirs and notebooks. This represents a major conceptual shift in approach that will provide a foundation for geoscience in the coming decades.

As the first steps in the process of change, in response to the Science Management Audit report, BGS has established a major core activity (called BGS-geoIDS) that will integrate its existing computer database systems. Part of this project is to develop a comprehensive metadata model adopting international standards, which will ease the integration of existing data in multi-disciplinary studies. It has also established the important "DigMap" project that is currently converting all the published geological maps into digital form.

The next innovative advance is the creation of the Digital Geoscience Spatial Model (DGSM), which will allow this information to be widely and simply accessed. A scoping study is currently developing a plan for its implementation. It will consist of two main parts: the DGSM-F, which is a Framework of databases for the storage of 3-dimensional data, applications, procedures and policies; and the DGSM-UK, which is the organised, systematic data for the UK, with the appropriate metadata and links to the knowledge base.

This proposal makes the case for additional resources from NERC to implement the plan: to establish the DGSM-F and to begin the process of constructing the DGSM-UK from existing information.

2 OBJECTIVES

The purpose of this project is to create a physical and cultural structure that will allow geoscientists from BGS to operate in a multi-dimensional environment, which will under-pin the whole range of BGS's public service and commissioned programmes. BGS will develop and maintain a series of consistent models that will consist of geologically defined points, lines, areas and volumes, with a wide range of geoscientific attributes, supported by structured, quality-controlled information and linkages to the observations and knowledge on which they are based. The models will provide input to a range of applications for visualisation, analysis and manipulation, and will ensure that the existing range of BGS products, such as maps and reports, will still be available. The system to be developed will build on existing technology and will be extendible and upgradeable. Policies governing the procedures and standards for dealing with data are already being developed in conformance with NERC Data Policy, and will ensure that appropriate licences are issued for use of the data and the system.

The DGSM-UK will have to be capable of incorporating many elements at a wide range of resolutions including: geological surfaces (including rockhead) based on map line-work, boreholes, trial-pits and excavations; deeper structures modelled on seismic, gravity and magnetic interpretations; large-scale representations of parts of the crust; geotechnical, geochemical and hydrogeological properties; mineral deposits; mine workings; cross-sections derived from structural analysis; fluid transport models showing saline incursions into aquifers and pollutant dispersal around land-fill sites. There will be structured links between the spatial models and the observational data, information contained in reports and publications, photographs and diagrams.

This proposal entails a radical new approach to the representation and visualisation of the BGS core spatial data and lies at the heart of the strategic plan for the future of BGS. Significant additional resources will be required in order to achieve the major technical developments and information manipulation.

3 PERFORMANCE TARGETS

BGS senior management regards the establishment, delivery and maintenance of the DGSM as an essential part of the national scientific responsibility of BGS. Monitoring of tasks identified to meet each of the project objectives described below will enable project performance to be determined, within an overall timeframe of 5 years.

4 RELEVANCE TO NERC STRATEGIES & PRIORITIES

'Looking Forward - The NERC Strategy for Science' identifies five major areas of concern on which NERC's scientific policy will focus. The DGSM addresses all of these directly as a source of quality-assured geoscientific information and as a platform for cross-disciplinary collaboration.

• ***Biodiversity***: The DGSM will capture and help understand the interaction between the lithosphere, the hydrosphere and the biosphere by providing the geological knowledge of the shallow sub-surface on which many ecosystems depend. The structure of the DGSM will allow any spatially referenced data to be included, easing communications between scientists from different disciplines.

• ***Environmental Risks and Hazards:*** Geological processes and human interaction with the subsurface are the direct cause of many catastrophic events. Information in the DGSM will assist in predicting and mitigating effects such as landslips, tunnel collapse, flooding, coastal recession as well as supporting studies of seismo-tectonic activity.

• ***Global Change:*** The geological record charts ancient global changes. With the current emphasis on evaluating Quaternary and Recent deposits resulting from glacial and postglacial events, the DGSM will provide baseline data against which the present climate and sea-level changes can be set, and future impacts assessed.

• ***Natural Resource Management*:** The DGSM will hold critical information on the distribution, genesis and dynamics of exploitable resources such as groundwater, minerals and hydrocarbons - both onshore and offshore, both shallow and deep. It will play an essential role in evaluating resources, planning their sustainable exploitation and assessing the impact on the environment and land-use.

• ***Pollution and Waste***: Safe management of waste is based on a sound knowledge of subsurface conditions. This information will form part of the DGSM. It will expedite planning repository structures and remedial strategies, and the prediction of risks to the environment from spillage of pollutants, in particular the effect on groundwater resources.

5 UTILITY & BENEFICIARIES

BGS has the most extensive geoscientific knowledge base in the UK. The development of the DGSM is the starting point for providing a range of opportunities and benefits to the whole user community: within NERC and especially in the commercial world. By creating a definitive set of geological spatial models for the UK, BGS will provide new perspectives and access into this information source.

UK has many heavily industrialised and populated areas with problems arising from prior

land-use, such as pollution from land-fill and industrial sites, rising groundwater and subsidence in mined areas, as well as conflict in use of land for exploitation of resources. There is available information that can be exploited to provide integrated solutions to many of these problems. BGS has already undertaken on behalf of clients several detailed 3-D modelling projects that will contribute to the DGSM.

Many geoscientists now expect to be able to view the solid earth in 3-D. For example, a hydrogeologist will be able to use and view all the data relevant to the investigation of a given aquifer, predicting and visualising the migration of pollutants through a rock-mass. An engineer will be able to use it in assisting in the prediction of rock properties for a tunnel. A number of geological surveys have recognised the need to take this step from 2-dimensional to 3-dimensional representation and there are currently parallel initiatives reaching some maturity, particularly in France and Australia, where significant collaborative scientific benefit is being seen. The hydrocarbons industry and minerals industries have committed themselves to this approach. The UK geoscience community must stay abreast of such developments in order to gain a better understanding of geological processes.

The perception of geology by the general public will be improved if solid-earth models and applications can be demonstrated and disseminated in effective, attractive ways, exploiting Internet technologies. Given the state of scientific development and the power of computer technology, together with possible release of key data-sets from oil and coal authorities, this project is timely.

6 RESOURCES SOUGHT AND CO-FUNDING

Currently BGS is spending £1.38 million of its annual Science Budget on activities that contribute directly to the DGSM concept. A further £3.4 million per year is being spent on activities that will be influenced by need to build the DGSM and that will be reshaped because of it, including the strategic geological survey work. It is anticipated that a period of 5 years will be required in order to establish the DGSM-F, to populate the models, test the system and generate outputs that can be tested against a range of users needs. Funding is sought via this proposal for £0.95 million per annum for five years (totalling £4.75 million). The new money will support about 20 staff in the project team. These will be IT specialists, carrying out system and applications development, geoscientists, carrying out data capture and attribution, and support staff. The DGSM will provide new opportunities for collaboration and co-funding with external bodies, including Higher Education institutes.

The overall budgetary requirement covers capital and other expenditure, relating to application licensing and any external contracts for conversion of analogue to digital data, research and software development.

7 STAFFING REQUIREMENT/STRATEGY

BGS derives its income from three sources: Science Budget, commissioned and commercial income and from product sales. In budgetary terms around 45% of the Survey's income is Science Budget. This means that at the start of the financial year around 250 staff years of effort are held in reserve for anticipated commissioned research and commercial activities. BGS will recruit on a project basis should commercial contracts be won later in the year that require additional staff not on the complement. There is available, therefore, a large resource pool, spanning the expertise range required for the DGSM, from which to draw staff, without the need to recruit new individuals for this project. Thus the request for funding herein will not entail any open-ended staffing obligations beyond the period of the project.

8 HOW THE OBJECTIVES WILL BE ACHIEVED

The current BGS DGSM Scoping Study has initiated the programme by reviewing existing standards, presenting general user requirements and developing the implementation plan. There will be two components to the project: development of the Framework and population of the DGSM-UK

8.1 Development and Management of the Framework

The first part of the work will be development of the systems that support the spatial models, requiring Information Technology specialist staff. The major elements are:

- the development of the detailed data architecture for the storage and data management of multi-dimensional geoscience data, building on, and compliant with, BGS-geoIDS,
- the development of a 'Data Warehouse' providing complete data-files, with structures tuned for particular applications, together with structured metadata to guide the user to them;
- the development of techniques for validation and attribution, linking to other information, audit systems and policies to ensure compatibility throughout the DGSM. These will be compliant with the BGS Quality Procedures and with both the BGS and NERC Data policies;
- the commissioning or licensing of interconversion applications components of the Framework;
- management and maintenance of the DGSM, co-ordination and validation of input into the DGSM; training the user community.

8.2 Population of the DGSM-UK

The second part will be concerned with the population of the models with key information and prioritised study areas. Input will be from geoscientists at all grades, reflecting the need of both experienced interpretation and routine processing of data, with support from IT staff.

The DGSM-UK will be developed over a considerable time beyond the period of this funding bid, with priorities reflecting the relative importance of the underlying geoscientific demands.

These priorities will be managed as discrete sub-projects within the DGSM project, with defined deliverables, milestones and schedules. The DGSM will provide information and guidance on the collection of new information to ensure ready incorporation into the models. Initially there will be six sub-projects, each designed to test the functionality of the DGSM and to provide a focal point for its long-term development, beyond the time covered by this proposal, with the long-term objective to provide models at suitable resolutions for the whole of the UK.

8.2.1 DigMap

The ongoing four-year DigMap project is due for completion at the end of Year 3 of the DGSM project. The intention is to digitise the totality of the 1:50,000 scale geological maps for onshore UK, complete the digitisation of the 1:250,000 maps of the continental shelf and digitise 2500 1:10,000 maps of urban Britain. Because this is essentially a production system, attribution of points, lines and polygons is limited to the 14 key attributes that describe the geological map. Extending the range of attribution and converting the 2-D data into 3-D through the DGSM, will ensure geological models at appropriate resolutions will be available for the whole of UK and the UKCS by the end of the period of the funding bid.

8.2.2 Regional DGSM for Southeast England

The greatest concentration of economic activity and urbanisation in the UK is in the Southeast of England, with a demonstrable demand for geoscientific information. Geoscience can help to provide solutions to problems concerning, for example, the engineering properties of Quaternary deposits and the underlying Tertiary and Cretaceous strata, rising groundwater levels, water supply and purity in the extensive Chalk aquifer, coastal erosion and accretion. A precursor of the DGSM concept in the London area (known as LOCUS) will provide a starting point for the wider area.

8.2.3 Regional DGSM for Midland Valley of Scotland Terrane

This sub-project covers the area of the Midland Valley Terrane, extending from the central part of the North Sea through the central belt of Scotland into Ireland. The area has been extensively mapped, has a long history of extraction of natural resources, and major centres of urban population. The legacy of the exploitation of geological materials has produced many effects that are now regarded as hazards. The project includes regional modelling to pilot the integrated and seamless modelling from onshore and offshore data sources and to provide an improved understanding of the development of the region. Detailed modelling of onshore areas will provide the information needed by planners to assess environmental and hazard impact (Note the relevance to the NERC URGENT studies in Glasgow).

8.2.4 Regional DGSM for the Atlantic Margin of the UK Continental Shelf

Enormous volumes of data are available for the Atlantic Margin to the UK Exclusive Economic Zone and further acquisition is continuing. Strategic survey programmes carried out by BGS on behalf of the Rockall Consortium are supplementing the data being gathered by the hydrocarbon industry. Data will also be derived from studies for the Western Frontiers Association, for EU-funded programmes, for the DTI and for the Passive Margin Modelling Project (PmmP). Additional contributions will also come from co-funded and commercial projects from individual industry partners and collaborative programmes in Irish, Faroese and Norwegian waters. The 3-D nature of much of the data lends itself particularly to the development of the DGSM and will lead to fundamental interpretations of our understanding of passive margins, plume driven volcanic provinces, sediment and fluid dynamics, and in environmental and hazard assessment.

8.2.5 Detailed Pilot Study of Great Yarmouth area

The Holocene deposits both on- and offshore around Great Yarmouth have been studied in considerable detail. The knowledge gained is relevant to the extractive and engineering industries (both important locally), to landfill programmes, to the use of groundwater, to the coastal erosion and conservation of the important habitats in the area, and to the NERC funded LOIS project. 3-D modelling in this area will test the methodology for dealing with very detailed information in the shallow subsurface and the differences in data sampling methods and density across the coastline. The sub-project is to be completed in year 2 of the funding bid.

8.2.6 Process Pilot Study of the Cheshire Basin

A multi-disciplinary study of the Cheshire Basin has recently been completed by BGS, producing an understanding of basin evolution, mineralisation and fluid movement (both ancient and modern). These studies provide a means of predicting locations of mineralisation, flow regimes, potential reservoirs of hydrocarbons and for predicting pollution of aquifers. The development of the methods within the DGSM for dealing with complex geoscientific problems addressed by a wide range of disciplines will prove to be a major stimulus to research effort, resource exploration and visualisation technology. The subproject is to be completed in year 2 of the funding bid.

8.2.7 "Fresh Starts"

A seventh element of the programme is scheduled to start in the second year. These "Fresh Starts" are likely to begin in the English Midlands, the Northwest and South Wales, which are areas with many of the problems associated with intensive industry and housing, and with good coverage of data. They will build on the experience gained in the regional and pilot studies. Offshore, the Atlantic Margin DGSM would be continued to link to the North and Irish seas, with their enormous economic importance. Science Budget funding will be redirected to co-fund these sub-projects. After five years the refocusing of the BGS Core Programme to support the DGSM will be complete. Additional support from commissioned funding will then be sought.

8.2.8 Sub-project Tasks

Each sub-project will incorporate many of the following elements of work to populate the models:

- Attribute geological maps to appropriate level;
- Convert 2-D geological lines into 3-D using digital topography/bathymetry;
- Interpret selected borehole logs for key surfaces;
- Interpret seismic reflection data and depth-conversion;
- Model gravity and magnetic data to interpolate key surfaces;
- Attribute surfaces and volumes with relevant geo-technical, hydrogeological, chemical and physical properties;
- Develop integrated surfaces, validating the results from different methodologies;
- Develop linkages to observed data and information;
- Prioritise new data collection and verify interpretations;
- Develop ‘Warehouse' datasets for particular purposes and applications;
- Compile and enter metadata;
- Test models and output.

Once the DGSM contains sufficient relevant coverage, commissioned projects will be able to draw on the DGSM data and feed the resulting improved and updated models and information back into the same structures. These might include:

- development of a DGSM for a radioactive waste disposal site, which will provide a very great density of data and intensity of research focussed on a small area;
- evaluation of water resources and risk to aquifers of the major basins funded by the Environment Agency, Water companies and DETR;
- mineral resource assessment, for key elements, mineral properties and potentially exploitable road-stone at depth (e.g. on the London Platform);

• detailed 3-D modelling of Quaternary deposits and shallow subsurface geology for organisations such as Rail Track, London Underground and civil engineering companies.

9 IMPLEMENTATION PLAN AND COSTS

In the funding model (Table 1) costs currently attributed to modelling activities related to the DGSM concept are carried forward into future years. The Science Budget funding for activities that will be influenced by the DGSM, such as ongoing collection of strategic data, is not included in these figures. We request enhanced funding to the level of 4.75 million over five years, in order to expedite the work. The execution of the project plan as described requires the full funding from both sources. The funds to cover staff costs, capital and minor expenditure are included in the total figures, including those for sub-contracted research and bureau services for digitising and software development.

Table 1: Funding Model

	Year 1: 2000/01			Year 2: 2001/02			Year 3: 2002/03			Year 4: 2003/04			Year 5: 2004/05			
	SB	HR	**Total**	SB	HR	**Total**	SB	HR	**Total**	SB	HR	**Total**	SB	HR	**Total**	TOTAL
DGSM FRAMEWORK																
Framework Development	40	160	**200**	40	100	**140**	40	60	**100**							**440**
Framework Management		150	**150**		150	**150**		150	**150**	20	180	**200**	20	180	**200**	**850**
DGSM-UK																
DigMap	850	150	**1000**	800	150	**950**	500	150	**650**		150	**150**		150	**150**	**2900**
S E England	234	110	**344**	235	110	**345**	240	130	**370**	250	140	**390**	260	140	**400**	**1849**
Midland Valley Terrane	200	110	**310**	200	110	**310**	200	130	**330**	200	140	**340**	200	140	**340**	**1630**
Atlantic Margin	42	110	**152**	45	110	**155**	150	130	**280**	150	140	**290**	150	140	**290**	**1167**
Great Yarmouth		80	**80**		50	**50**										**130**
Cheshire Basin		80	**80**		80	**80**										**160**
Fresh Starts					90	**90**		200	**200**	500	200	**700**	500	200	**700**	**1690**
TOTALS																
Science Budget	**1366**			**1320**			**1130**			**1120**			**1130**			**6066**
Head Room		**950**			**950**			**950**			**950**			**950**		**4750**
TOTAL			**2316**			**2270**			**1980**			**2070**			**2080**	**10816**

N.B. Figures are given in £000
SB is Science Budget Allocation
HR is Proposed Head Room Funding

10 SCHEDULING

A detailed implementation plan is being developed within the scoping study. Table 2 shows how the sub-projects are to be scheduled, with their main activities and deliverables for each.

Table 2: Implementation Plan

	Year 1 2000/01	Year 2 2001/02	Year 3 2002/03	Year 4 2003/04	Year 5 2004/05
DGSM Framework					
Framework Development					
Architecture	* * *				
Warehouse	* * *				
Procedures & QA	* * *	* *	* *		
System testing		* *	* *		
Framework Maintenance	* * * *	* * * *	* * * *	* * * *	* * * *
DGSM-UK					
DigMap					
Additional attribution	* * * *	* * * *	* * * *	* * * *	
1:250,000 3-D UK modelling & testing		* *			
1:50,000 3-D UK modelling & testing			* *		
1:10,000 3-D modelling & testing					* *
SE England					
LOCUS conversion	* * * *				
Chalk aquifer conversion		* * * *	* * * *		
Tertiary & Quaternary conversion			* * * *	* * * *	
Aquifer & Geotechnical modelling, testing & warehouse			* * * *	* * * *	* * * *
Midland Valley Terrane					
Conversion of on- & offshore mapping	* * * *	* * * *			
Extension of attribution as appropriate		* * * *			
Interpret boreholes, mine-plans and structure contours	* * * *	* * * *	* * * *	* * * *	
Collation of rockhead, superficial & environmental data		* * * *	* * * *	* * * *	
Interpretation, modelling, testing and warehouse				* * * *	* * * *
Atlantic Margin					
Conversion of 3-D mapping	* * * *				
Extension of attribution	* *	* * * *	* * * *	* * * *	
Rock & fluid properties		* *	* * * *		* * * *
Addition of environmental aspects		* *	* * * *		
Modelling, testing & warehouse creation				* * * *	* * * *
Great Yarmouth					
Conversion of 3-D mapping	* * * *				
Collation of topography & bathymetry	* *				
Digitisation of mapping with extended attribution	* *	* *			
Modelling of on & offshore superficial deposits		* *			
Modelling geotechnics & hydrogeology		* *			
Testing & warehousing models		*			
Cheshire Basin					
Digitisation of data	* * * *				
Developing methods for process model	* *	* *			
Building process model		* *			
Testing process model & warehouse		* * * *			
Fresh Starts					
Midlands rising groundwater, contaminated land		* *	* * * *	* * * *	* * * *
South Wales contaminated land			* * * *	* * * *	* * * *
NW England/ & Wales land-use				* * * *	* * * *

APPENDIX 3 Terms of Reference for the DGSM Mid-Term Review Group

1. To report its findings to the NERC Science Innovation and Strategy Board by 31st December 2002.

2. To meet the DGSM Management Group to evaluate their views on the DGSM programme of work.

3. To meet staff working on the DGSM to evaluate their views on the management of the DGSM programme.

4. To seek the views of BGS staff on the uptake of the DGSM to their work in the wider BGS.

5. To inspect and evaluate the DGSM system, with assistance as necessary

6. To assess progress on the development of the DGSM as defined in the proposal

7. To identify variations from the proposal and to comment on their significance

8. To comment on cost-effective use of resources

9. To identify aspects of the work that requires additional effort and those where it might be reduced.

APPENDIX 4 Agenda for Presentations and Interviews

Digital Geoscience Spatial Model (DGSM) Mid-term Review
Presentations & Interviews: Thursday 10th October 2002
MR2: BGS, Keyworth

AGENDA

Presentations

09:00 DGSM overview I: The need and its position within the long-term strategy of BGS. Including some comment on budgetary considerations**. Ian Jackson.**

09:30 DGSM overview II: The scientific and technological concept. Setting the scene for following presentations. Project management. **Ian Smith and Richard Shaw**

10:00 DGSM-F: Data Architecture. **John Laxton**

10:30 DGSM-F: Data Linkages. **Patrick Bell**

Demonstrations

11:15 DGSM-UK: UK Regional Model. **Bruce Napier**.

11:50 DGSM-UK: Humber Estuary. **Holger Kessler.**

Lunch and time for panel to reflect on the presentations and demonstrations

Interviews

14:00 **DGSM Steering Group** (Ian Jackson, Mick Lee, Dave Holmes, Richard Shaw, Ian Smith).

14:30 **John Laxton** (Data Architecture, Metadata)

15:00 **Andy MacKenzie** (Best Practice)

15:45 **Steve Mathers** (User)

16:15 **Richard Ellison** (User)

16:45 **Chris Evans** (Software Standards, Training)

APPENDIX 5 DGSM Projects

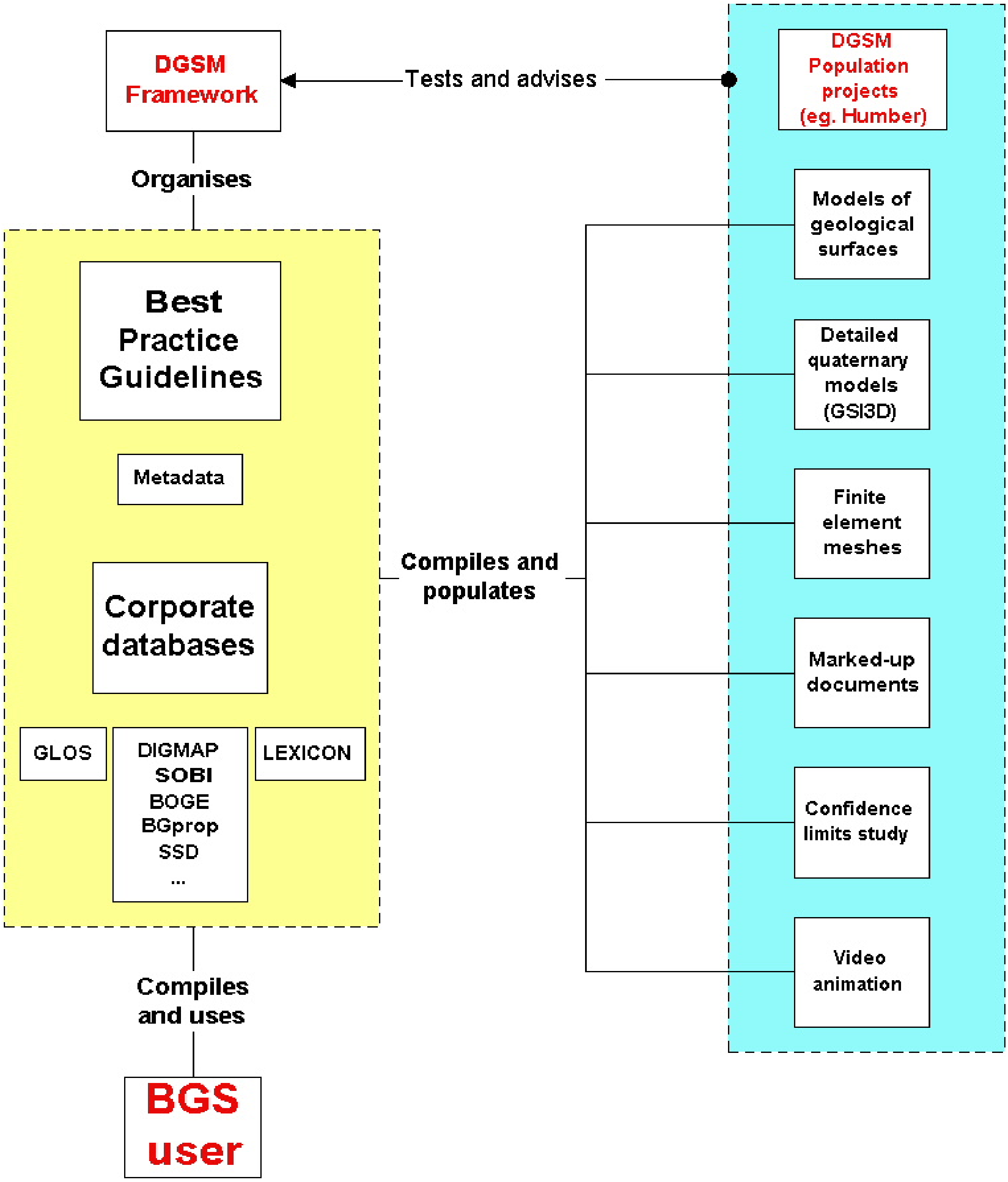
DGSM-F

- Data Architecture
- Data Warehouse
- Metadata
- Database Tools
- Software Standards
- Data Linkages
- Best Practice
- Authoring
- Training
- Project Management

DGSM-UK

- Atlantic Margin
- Cheshire Basin
- Notts/Melton
- Humber Estuary
- Midland Valley
- SE England
- DigMap
- UK Model (1:1 Million scale model of the UK)

APPENDIX 6 Humber Project Workflow Chart



A simplified workflow highlighting the main processes, inputs and outputs of a DGSM population project. Its main function is the testing and advising of the DGSM Framework and the population of corporate databases.

APPENDIX 7 The DGSM Steering Group

Members:

- ***Mr Ian Jackson*** (chairman): Director of Information Services & Management
- ***Dr Mick Lee***: Director of Lands & Resources
- ***Mr Dave Holmes***: Director of Environment & Hazards
- ***Dr Bill Hatton***: Head of Discipline, Information Systems
- ***Dr Roger Scrutton***: BGS Board Member, University of Edinburgh
- ***Dr Richard Shaw***: Sector Manager, Geochemistry, Mineralogy & Hydrogeology
- ***Mr Ian Smith***: DGSM Programme Manager

APPENDIX 8 Summary of Internal Reports

REPORTS PRODUCED THROUGH THE DGSM PROJECT, LISTED BY PROJECT.

(Copies available on request)

Data Architecture Project: Leader – J L Laxton

Brief summary of outputs:

Agreed user requirement
Spatial data store logical model
Trial applications definition

Geoscience Large Object Store Project: Leader – A T Riddick

Brief summary of outputs:

Data model for initial object store
List identifying the wider range of data types available at
http://kwnts99:82/scripts/dgsm/GLOS/ObjectInventory2.htm
Application specifications
Revised Prototype application available at
http://kwnts99:82/projects/dgsm/glos/menu_A.htm
Report on suitability of ORACLE-8 for GLOS (Draft report available)
Evaluation report on InterMedia (Draft report available)

Metadata Project: Leader –J L Laxton

Brief summary of outputs:

Report giving the results of the review and making recommendations on the thesaurus to be implemented: Q:\Pubs\Docs\IR\2001\IR01173.pdf
Metadata tables, ORACLE tables available
Constraint dictionaries available
Metadata input application specification:
V:\ISM\DGSM\Framework\MetaDatafiles\MetadataUserGuide\discovery_metadata_entry_spec.doc
V:\ISM\DGSM\Framework\MetaData files\MetadataUserGuide\inference_metadata_entry_spec.doc

Prototype interfaces available at http://kwnts99:84/scripts/reh/DGSMmetadata/start.cfm

Metadata validation/retrieval application specification

Development of Applications Project: Leader –P Bell

Brief summary of outputs:

Test Z attribute extraction application
GLOS input applications available at: http://kwnts99:84/dgsm/glos/menu.htm

Metadata input applications available at:
http://kwnts99:84/scripts/reh/DGSMmetadata/start.cfm

GLOS output application available at: http://kwnts99:84/dgsm/glos/menu.htm

Metadata output applications available at:
http://kwnts99:84/scripts/reh/DGSMmetadata/start.cfm

GiD is available
DTM extraction applications available via Data Portal at:
http://kwnts99/website/jmca/dgsmmod/viewer.htm

A number of examples of animations and fly throughs

Software Standards Project: Leader –C J Evans

Brief summary of outputs:

Beta-test version of Data Portal available at:
http://kwnts99/website/jmca/dgsmmod/viewer.htm

Data Linkages Project: Leader –P Bell

Brief summary of outputs:

GIS Interface available at: http://intranet/projects/dgsm/dgsm_access.htm#

Web-based forms available at: http://kwnts99:84/scripts/reh/DGSMmetadata/start.cfm

Cheshire Textbase interface available at:
http://kwnts99.nkw.ac.uk:84/dgsm/textbase/home.html

Integrated DGSM interface available http://kwnts99:84/reh/gateway/

DGSM web pages accessed at: http://intranet/projects/dgsm/dgsm_home.htm

Best Practice & Quality Systems Project: Leader –A C MacKenzie

Brief summary of outputs:

QA Implementation strategy report BGS report IR/02/164R
DGSM Best Practice Guidelines BGS report IR/02/156

Authoring Project: Leader –T R Duffy

Brief summary of outputs:

Prototype ML available at: http://intranet/projects/dgsm/textbase/frontpage.htm
Feedback on Prototype ML is available at:
http://intranet/projects/dgsm/reports/Questionnaire_Responses5.doc
Text database structure available

Training: Leader –C J Evans

Brief summary of outputs:

Various training courses delivered and others scheduled

Project Management: Leader –I F Smith

Brief summary of outputs:

Project Plans
Monthly project progress reports
Progress reports for augmented reality project
Conference Paper presented
V:\ISM\DGSM\presentations/geoscience_modelling.ppt
Spa conference attended Jul-01. PPT at: V:\ISM\DGSM\presentations/spa.ppt
BGA/RAS conference Feb 02. PPT at V:\ISM\DGSM\presentations/RAS-BGA.ppt
Meetings held: 4 roadshows, 2 BGS presentations held in 2001-2

Newsletters available at: http://intranet/projects/dgsm/announce/newsletters.htm

Active Intranet site at: http://intranet/projects/dgsm/dgsm_home.htm

DigMap Enhancement Project: Leader –R Armstrong

Brief summary of outputs:

Application is available to attribute DigMap linework
DTM is available via Data Portal
http://kwnts99/website/jmca/dgsmmod/viewer.htm
Best Practice documents/checklists

S E England Project: Leader –S J Booth

Brief summary of outputs:

Draft report on best practice available
A collection of models & metadata in appropriate databases
South Downs model provided
Draft report on best practice available
WP Atlas software is available in beta-test version

Midland Valley Project: Leader –M C Akhurst

Brief summary of outputs:

Brief report on Best practice QC of modelling activities
Metadata available
Various earthVision models of Midland Valley map sheet areas available

Atlantic Margin Project: Leader –J D Ritchie

1.1.1.1.2.1.1 Brief summary of outputs:

EarthVision 3D model
Best practices methodologies report published
ERMapper stratigraphic surfaces
Marked-up text available and loaded to database
Populate GLOS and test DGSM - Phase 1 (2001/2) complete. Digital files (including grid) of earthVision 3D model and figures from the text have been sent to GLOS
Marked-up text available and loaded to database

Populate GLOS and test DGSM - Phase 1 (2001/2) complete. Digital ERMapper grid file and diagram from the text have been transferred to GLOS
Models of key Neogene stratigraphic surfaces (phase 1)
Models identified
earthVision 3D model of key surfaces
GoCAD 3D model of key surfaces

Humber Estuary Project: Leader – H Kessler

Brief summary of content:

Surface models for TA11 available in GLOS
Assessment of quality of surfaces
Surface models for whole Humber Estuary area

Cheshire Basin Project: Leader –D G Jones

Brief summary of content:

Revised models available in GLOS at http://kwnts99:84/dgsm/glos/menu.htm
Cheshire Basin report at: http://intranet/projects/dgsm/textbase/frontpage.htm
Fluid flow model available
1D basin evolution model available
2D basin evolution model available
Demonstration Cheshire Basin DGSM at:
http://intranet/projects/dgsm/textbase/frontpage.htm

UK Regional Model Project: Leader – B Napier

Brief summary of content:

List of key surfaces is at: V:\ISM\DGSM\PopulationProjects\UK-regional/UNCONFORMITIESLIST.xls

Report on UK Velocity model at: Q:\Pubs\Docs\IR\2001\IR01173.pdf

Nottingham-Melton Project: Leader –N S Jones

Brief summary of content:

Key surfaces agreed
Database of xyz geological data for Cotgrave sub-area available
Database of xyz geological data for whole area available
Digitised coalmine abandonment plans available
DTM available
Geological polygons available
Availability of basic digital data for modelling
Cotgrave area model available

DGSM Reports available on Intranet October 2002

Background

Digital Geoscience Spatial Models and the Future of the Geological Map: T V Loudon

DGSM Scoping Study: Ian Smith, Maxine Akhurst, Jerry Giles, John McInnes, Richard Shaw

DGSM Proposal Document: Dr P M Allen

DGSM Concept Statement: Ian Smith, Maxine Akhurst, Jerry Giles, John McInnes, Richard Shaw

NERC ESTB Bid: Ian Smith

Framework

Internal Report IR/00/49
Quality Considerations for the Digital Geoscience Spatial Model (DGSM): Shaun Reeder

Internal Report IR/01/57
Review of metadata standards for the DGSM Programme: J L Laxton

Internal Report IR/01/61
Metadata Specification for the Digital Geoscience Spatial Model: J L Laxton, K A Holmes, A A McKenzie
Internal Report IR/01/173
A Review of Geoscience Thesauri to Constrain Subject Keywords in DGSM Metadata: Rachel Heaven

Text Capture and Integration in the DGSM and SIGMA
A summary of questionnaire responses for the Cheshire Basin gateway prototype and discussion of the way forward: Tim Duffy

Pilot Studies

Internal report IR/01/188
The UK Seismic velocity model for earthquake location - a baseline review:
D C Booth, JDJ Bott, A M O'Mongain

Text Capture and Integration in the DGSM and SIGMA
A summary of questionnaire responses for the Cheshire Basin gateway prototype and discussion of the way forward: Tim Duffy

Best Practice

WP Atlas Best Practice: Paul Williamson

3D Integrated Land Survey Modelling: Alison Monaghan

Digital Geoscience Spatial Model (DGSM) - Best Practice Guidelines: Andrew McKenzie

Best Practice Guidance

Best Practice checklist and guidance pro formas and guidance notes are available from: v:\ism\dgsm\best_practice, and around a dozen completed guidances and checklists at v:\ism\dgsm\best_practice\submissions.