THE UNITED KINGDOM NATIONAL REPORT FOR PHOTOGRAMMETRY AND REMOTE SENSING 1992 - 1996

Prepared for the UK National Committee for Photogrammetry and Remote Sensing
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ABSTRACT:

The National Report of the United Kingdom describes current activities and new developments in photogrammetry and remote sensing during the period 1992-1996. The sectors involved are classed as governmental, private commercial and educational organisations, as well as suppliers of systems and equipment, consultancy, contract services and users. The nature of the balance between photogrammetric and remote sensing interests is assessed and techniques and applications of each are categorised. Changes in the levels of activity since 1992 are tabulated and the nature of new research and organisational development are considered. The changing relationship between the constituent UK societies and organisations concerned with Geographical Information Systems (GIS) is noted as a feature of the report period.

COMPILATION OF THE REPORT:

This short report follows the pattern established in 1992, in respect of the new ISPRS restriction on page length. The information presented is derived partly from 4-pp questionnaires circulated to UK organisations concerned with photogrammetry and/or remote sensing and partly from the authors' personal knowledge of activities. The questionnaire included both photogrammetry and remote sensing questions. A total of 130 questionnaires were distributed and replies were received from 98 [75%]. The authors are members of the Councils of the Photogrammetric Society and the Remote Sensing Society respectively, and the first author is additionally a member of the UK National Committee for Photogrammetry and Remote Sensing. Opinions expressed by questionnaire respondents and by the authors do not necessarily reflect the views or policy of the UK National Committee.

1. INSTITUTIONS AND PUBLICATIONS

The UK National Committee for Photogrammetry and Remote Sensing is the adhering body to the International Society for Photogrammetry and Remote Sensing and is funded by the Royal Institution of Chartered Surveyors, the Photogrammetric Society and the Remote Sensing Society.

Separate societies continue to cater for the photogrammetric and the remote sensing communities in the UK. The Photogrammetric Society was founded in 1952, and currently has 315 UK and 183 overseas individual members, which represents a drop of 20% on the total of individual members reported in 1992. There are also 39 corporate members, including 7 overseas corporate members, which represents a drop of 30% on four years ago. The official journal of the Society is the Photogrammetric Record which continues to be published twice yearly and is issued free to members. Since October 1992 the Photogrammetric Record has published 87 refereed articles of which the authors of 60 articles are resident in the UK and 27 resident abroad. In addition, shorter contributions, abstracts, book reviews et alia are published enhancing the journal's high international reputation. In addition the Photogrammetric Society distributes a newsletter three times a year.

The Remote Sensing Society was established in 1974 and celebrated its 21st birthday in 1995. As well as coordinating and promoting remote sensing activities, a significant role of the Society is in the encouragement of commercial and government participation in remote sensing, both nationally and internationally. Current membership levels are relatively stable at around 800 members.

In 1995 a new membership structure was introduced which was designed to recognise levels of achievement in remote sensing, with membership grades ranging from Ordinary members, and with elevation to the grades of Member or Fellow with the concomitant styles of MRSSoc and FRSSoc respectively, dependent on appropriate levels of qualification and experience, as decided by the Professional Standards Committee. Great emphasis is placed on Corporate membership which is open to commercial organisations, research institutions or university departments. Student membership is also available and represents a significant group within society.

The society continues to operate its Special Interest Groups in Education, GIS, Geology, Field Spectroscopy and Ocean Colour. This has recently been augmented by two new groups: in Archaeology and SAR. The official publication of the Society is the International Journal of Remote Sensing, currently running at 18 issues per year, and it also publishes a quarterly Newsletter, an annual report and occasional monographs. The Society operates an electronic bulletin board containing general information and notes on opportunities relevant to remote sensing. A number of awards are given by the Society ranging from the Remote Sensing Society Award and Gold Medal for distinguished achievement in remote sensing to travel bursaries and support for research in progress. The major event is the Annual Conference at which the Annual General Meeting of the Society is held. Other one and two day meetings and workshops are held, often run by the Special Interest Groups and in conjunction with other Societies.

The Society has a large overseas membership and seeks to cater for the needs of these members by promoting their research and providing a forum for the exchange of expertise and knowledge. The Society also continues to develop its links with other Societies both within the UK and abroad, including the Photogrammetric Society, the Royal Institute of Chartered Surveyors and the French Society for Photogrammetry and Remote Sensing (with whom a successful joint conference was held in 1994) and the Dutch RS and Photogrammetric Societies. In addition to these activities, the Society also works in collaboration with the European Association of Remote Sensing Laboratories (EARSeL) and has been officially represented at a number of meetings of other overseas societies.

The Remote Sensing and Photogrammetric Societies still remain entirely distinct in the UK although members continue to enjoy the reciprocal benefits of preferential registration rates at society events. Analysis of the membership lists of the two societies shows only a small overlap of individual members (mainly from education establishments) or of corporate members (mainly from government institutions).

The Survey & Mapping Alliance (SMA), formed in 1989, was wound up in 1994, following the fourth UK national Survey and Mapping conference in 1993, but most of the participating societies and institutions of SMA, including the Photogrammetric Society, recombined in November 1994 to form the Survey & Mapping special interest group of the Association of Geographic Information (AGI), which holds an annual conference and exhibition.

NAPLIB continues as an independent but small organisation promoting the use and preservation of aerial photographs. Its Directory of Aerial Photographic Collections in the UK published in 1993 is the best single source of information on 372 collections, and work on a second edition is in progress.

1.1 Types of organisations

The private sector accounts for over half the organisations involved in photogrammetry and remote sensing and educational establishments account for about a quarter of the total (Table 1.1). Government-funded organisations account for the balance (17%). These figures are based on the questionnaire returns, which include all the larger organisations with photogrammetric and/or remote sensing activities. For smaller private and education organisations, the remote sensing returns are thought to be under-representative.

TABLE 1.1 Organisation by type and activities:

	Photogram	R.S.	Both	Totals
Government funded	3	6	8	17
Private	26	20	7	53
Education and non-profit	6	15	7	28
Totals	35	41	22	98

2 . PHOTOGRAMMETRY

This section of the report is sourced from corporate and individual membership of the Photogrammetric Society. In the United Kingdom photogrammetry continues to be a specialist scientific operation employing only a few hundred persons in total. Realistic figures are difficult to assemble because most persons working in photogrammetry do so as a component of a larger discipline. For example, lecturers in tertiary education will frequently teach photogrammetry within topographic or cartographic science; and experts in such technical fields as archaeology, architecture, civil engineering and medicine may use photogrammetry as a small component of their data capture and analysis.

The developing merger between photogrammetry, remote sensing, automated cartography and geographical information systems (GIS) also makes it difficult to identify photogrammetrists as members of an independent profession. The spectacular increase in the use of PCs and workstations as a tool in laboratory measurement and analysis has aided the move towards digital photogrammetry and compounded the integration of photogrammetry within the general subject of mapping science. While the term geomatics has not established itself in the UK, the term photogrammetry does not fully represent the subject that some former photogrammetrists are now engaged upon.

The questionnaire returns illustrated the problems of distinguishing photogrammetric and remote sensing operations from each other and from the broader area of spatial science. It was noted that the returns of many questionnaires sent to organisations thought of as photogrammetry-orientated showed both photogrammetric and remote sensing activities, whereas the questionnaires sent to organisations thought of as remote-sensing orientated sometimes also showed photogrammetric activity.

2.1 Changing patterns of employment

The current pattern of employment in photogrammetry is presented in Table 2.1. The three organisations devoting more than 25 person years include two (Ordnance Survey and BKS Surveys) that were in the same position in the previous reporting period, plus Kvaerner Surveys, while the Directorate of Military Surveys has dropped into the 6-25 person year category. Of the other 16 organisations devoting 6-25 person years to photogrammetry, the Ordnance Survey of Northern Ireland is involved in national mapping and there are two education establishments (City University and University College London(UCL)) and one special case, the Institute of Information Scientists. The remaining twelve organisations are commercial companies, of which nine are principally concerned with project mapping, and three with the production and distribution of equipment, software and products. The majority of organisations devote fewer than 6 person years to photogrammetry and the lowest category in Table 2.1 is probably an under-estimate because of lack of contact.

TABLE 2.1 Organisations providing employment in photogrammetry and estimates of numbers of full time staff:

Employment (person years)	Number of organisations	Number employed (person years)
Over 25	3	90
6-25	17	204
1-5	22	55
Less than 1	19	9
Totals	61	358

The total number of organisations and number employed are slightly less than the corresponding numbers for the previous reporting period but, given the approximate nature of the sampling process, no conclusions should be drawn from this.

2.2 Applications

The photogrammetric applications described by the questionnaire respondents cover a wide range (Table 2.2). It is noticeable that only 4 education establishments apply more than 50% of the photogrammetry to education/training, most time being spent in research.

The largest single application is in project mapping, by commercial companies, followed by national mapping and national resource surveys, which include both topographic and thematic data collection. Manufacturing, distribution and support for equipment and software is the sole application of a small group of respondents, and numerous commercial companies devote a minor proportion of their photogrammetric application to education/training. Generally most organisations cover a range of applications.

TABLE 2.2 Applications of photogrammetry:

	Main >50%	Major 10-50%	Minor <10%
Institution/Profession/Trade matters	1	-	2
Education/Training	4	6	12
Research	-	16	5
Consultancy	2	12	6
Manufacture/Software development	4	2	-
Distribution/support/maintenance	4	3	1
National Survey	5	7	-
Project Mapping	14	8	5
National Resource Survey	2	5	1
Project Resource Survey	3	3	1
Protection of Environment	2	4	4
Defence/Police/Emergency Services	1	1	3
Hydrology/Oceanography	-	-	3
Meteorology/Space	-	-	1
Monitoring Change	-	6	4

2.3 Techniques

The list of photogrammetric techniques used by the respondents (Table 2.3) indicates that photogrammetry using aerial photographs remains the dominant application, but a marked feature is the increased use of close-range techniques for architecture, industrial engineering, archaeology and medical/science compared to the situation four years ago.

TABLE 2.3 Photogrammetric techniques used:

Photogrammetry using space imagery	12
Photogrammetry using aerial photographs	43
Photogrammetry using video/scanned aerial imagery	22
Architectural photogrammetry	26
Industrial/engineering photogrammetry	25
Archaeological photogrammetry	19
Medical/scientific close-range photogrammetry	10
Photogrammetry with GIS	27

While medical photogrammetry has not registered any significant change, the other listed branches have registered growth, mostly through the agency of small specialist companies or university departments. The linkage of photogrammetry to GIS through the increased application of digital techniques is a further development.

2.4 Education

The tertiary education sector in the UK has seen considerable change in the last four years, with the upgrading of polytechnics to university status and the progressive cut-back in funding to universities by central government, leading to internal financial constraints. University photogrammetric units have had to generate funds for additional equipment through funded research projects or by an increased intake of students. The net

result is further constraint on the replacement of specialist staff on retirement or of equipment except by a small number of institutions. Apart from City University and UCL, the number of photogrammetric teaching staff in each department is 1-2. Nevertheless all educationalists except two report a modest expansion of photogrammetric activities in the four year period, linked in all cases to the introduction of digital photogrammetric systems, most commonly lower-cost systems suitable for educational instruction.

Except in specialist university departments of photogrammetry and surveying, such as UCL, Newcastle University, City University and the University (formerly Polytechnic) of East London, timetable pressure ensures that photogrammetry is increasingly taught as an integral component of spatial data handling. For example, in the MSc in Topographic Science course at Glasgow University, photogrammetry is now taught within the cartography and geoinformation technology stream. This trend has been accentuated by the increased prominence of GIS and facilitated by the advent of digital photogrammetric systems.

The four-month certificate course in Air Survey Photography introduced by UCL in 1991 has subsequently run in 1992, 1994 and 1996. The perceived demand for a photogrammetric operators' training course is not currently being met in the UK.

To assist in the promulgation of photogrammetry in the UK to the science community generally and to occasional users, the Photogrammetric Society is initiating a number of simple promotional and educational measures.

2.5 Facilities and projects

Facilities in the United Kingdom for government and private commercial companies remain adequate. While the number of air survey aircraft for metric photography has remained constant (5), an increasing number of aircraft are used with small format film and digital cameras for aerial reconnaissance activities, often for promotional oblique photography. FMC has become the industry standard on metric air survey cameras, and second-hand cameras fitted with FMC are being purchased by smaller organisations. Air survey and terrestrial cameras for contract or internal use are common.

The Ordnance Survey has purchased 3 analytical plotters for rural revision work and more recently 12 monoplotting workstations have been introduced for scanner and orthorectification procedures, also for rural revision work.

The number of digital photogrammetric systems has increased sharply but in two contrasting ways: the low cost DMS unit has been introduced in significant numbers by educational establishments and in one case by a private company as an additional work unit; higher quality digital workstations have been introduced by a few private companies and by specialist educational establishments.

The overhaul of rural revision mapping started by the Ordnance Survey in the 1950s has finally been completed, and the subsequent rolling revision of the Ordnance Survey 1:2,500 scale map data for rural areas is generating work for private companies. Surveys for major motorway design are expected to decrease but are still providing a main source of work. The Channel Tunnel rail link and associated infrastructure has required extensive route surveys and mapping.

Major close range projects have included the architectural and archaeological recording at Windsor Castle after the disastrous fire in the State Apartments in November 1992; and the archaeological and topographic recording at Stonehenge, both projects by English Heritage. A programme of architectural recording of all Royal Palaces and other major buildings is in operation. The British Antarctic Survey continues its programme of mapping in Antarctica using small format aerial photography, GPS and satellite imagery.

2.6 Research and development

Instrument manufacture and software development in the UK continues to be in the hands of a very small number of organisations. Cartographic Engineering, apart from its very successful scanning stereoscopes and AP190 analytical plotter, introduced the CP2 analytical plotter and associated software in 1993 and the HS 1, the first of a planned new range of mirror stereoscopes with digital height readout, in 1995. Ross Instruments produced a new analytical plotter AP2000 in 1996.

UCL has developed a remote digital measurement system for work in hazardous (radioactive) environments using CCD based cameras. Other areas of current research at UCL include automated digital photogrammetry and machine vision; as-built surveying of industrial plant; topographic mapping from satellite imagery; and medical photogrammetry for reconstructive surgery. Newcastle University is testing a Photo CD for converting images into digital form, and City University is researching into automated 3-D measurement using multiple CCD camera views, as well architectural and engineering plant modelling.

2.7 Significant changes in the period 1992-1996

While photogrammetry in the UK has the attributes of a mature enabling science, continued developments in related technologies have consolidated photogrammetry's position within spatial data management. Although economic factors have increasingly dominated policies and schedules in governmental, private and educational organisations, and act as a major constraint, nevertheless developments and initiatives are apparent.

- Analytical plotters have effectively replaced analogue plotters for production processes, for example in the Ordnance Survey, Photarc Surveys and Atkins AMC, although many analogue plotters, often with digital encoders, remain in educational establishments.
- Analytical plotters have provided an impetus to close-range photogrammetry, for architectural and industrial plant operations.

- Digital photogrammetry has enjoyed a strong initial growth in close-range operations and within those organisations, for example the British Geological Survey, already possessing skills in digital image processing of remote sensing scenes.
- Some private companies, originally in surveying or cartography, have moved into digital photogrammetry with little traditional photogrammetric experience.
- High resolution scanners have been introduced.
- The emergence and development of new software products (DEMs, orthophotos) based on PC/Windows solutions has been rapid.
- Orthophotographs are being marketed as an independent product by Hunting Aerofilms, BKS, SDS, and NRSC, and used as a component of project mapping by other organisations. An undeveloped market for orthophotos is seen to exist in planning, tourism and the utilities.
- GPS including airborne GPS has rapidly established prominence for photo-control.

2.8 The contribution overseas

Almost three quarters (72%) of the responding organisations listed overseas areas of operations, in many cases involving global connections with more than ten overseas countries. All of the larger private organisations reported substantial overseas commitments, in project mapping, environmental modelling, consultancy and trade.

All but two of the universities reported the registration of overseas students, from a wide range of countries, for postgraduate taught and research degrees.

The wide UK involvement in overseas photogrammetric activities is reflected in the fact that the only government funded and private organisations not involved are a few of the small private companies and those government organisations specifically dealing with the United Kingdom.

3. REMOTE SENSING

This section of the report was sourced from corporate, research institute and academic membership of The Remote Sensing Society. Whilst it is anticipated that the majority of the UK 'professional' remote sensing community was consulted, this survey may not be representative of the total user-community in the UK as a whole as the technology finds its way across disciplines and to lower levels in the educational sector. Thus, smaller users and those who use remote sensing only incidentally may well not have been included in the survey. As an example, the Remote Imaging Group (RIG) currently boasts a UK and worldwide membership of 2150 in 1995, an increase from 1300 in 1992. RIG is an amateur based organisation with members either hobbyists, semi-professionals or having educational interests in remote sensing and satellite systems in general. Most members are interested in the technical challenges of receiving and decoding meteorological satellite data. The large expansion in four years reflects the increasingly popularity of remote sensing and related technologies and the availability of equipment affordable to the enthusiast.

The major structural change in Governmental involvement in remote sensing since 1992 has been two-fold. Firstly, in 1993-4 research funding for Earth Observation was unified under the umbrella of the Natural Environment Research Council which took over responsibilities for atmospheric and instrumental research from the former Science and Engineering Research Council, in addition to its existing remote sensing duties and interests. The change in total funding to NERC has perhaps led to a swing towards an applications and user-led remote sensing research emphasis and away from technologically-driven developments. The second most notable change has been the increasing support for remote sensing from the Government through the British National Space Centre, the organisation established in 1985 charged with carrying out governmental space policy. BNSC's initiatives have largely been through its Link and Applications Development Programmes to designed both to stimulate greater involvement and collaboration between academic research and industrial organisations as well as to stimulate 'near-market' research into operational and commercial applications with the involvement of end-users.

3.1 Changing patterns of employment

Data for this analysis were obtained using questionnaires sent to corporate members of the Remote Sensing Society, as well as to research institutes and university departments with a known strong interest in remote sensing applications and research. Of the 55 questionnaires sent out, 37 were returned, a response rate of 67%. Of these 16 came from private companies, 14 from higher education institutions and 7 from research institutes.

In terms of changing patterns of employment, the responses produced the breakdown according to size as shown in Table 3.1. Only two organisations, both private, admitted to less than 1 person year of effort per annum for the period 1992-96. Sixty percent of those responding employed over 6 people, with two organisations claiming over 100 person years in remote sensing and related activities, including the clerical and managerial support required to undertake involvement at such a level.

TABLE 3.1 Responses to annual effort expended in remote sensing research to 1992 and 1996 (figures in brackets indicate percentages).

Employment (person years)	Number of organisations (1989-92)	Number of organisations (1992-96)
Over 25	12 (11.5)	8 (22.2)
6 - 25	29 (27.9)	14 (38.9)
1 - 5	48 (46.2)	12 (33.3)
less than 1	15 (14.4)	2 (5.6)

In comparison to the previous period (1989-92) remote sensing activity has expanded with a shift to a higher number of person years reported for the 1992-96 period, with one-third more companies reporting increased effort expended. This trend concurs with responses to a separate question in which 23 respondents (64%) indicated that their remote sensing activities had expanded during the 1992-96 period whilst 10 (28%) noted that activities had remained at a constant level. Only three organisations, all from the private sector, indicated that their remote sensing activities had in fact declined during the time period.

3.2 Applications

Respondents were asked to apportion their activities in remote sensing to the applications listed in Table 3.2. Although some confusion in interpreting the question is acknowledged as the categories are not necessarily mutually exclusive, types of activity were usually further broken down into particular applications.

TABLE 3.2 Applications and activities of remote sensing organisations:

	Main > 50%	Major 10 - 50%	Minor < 10%
Institution/Profession/Trade matters		1	1
Education/Training	8	14	2
Research	11	15	
Consultancy		16	2
Manufacture/Software development	4	6	2
Distribution/support/maintenance	1	2	2
National Survey			
Project Mapping		2	
National Resource Survey			1
Project Resource Survey		3	1
Protection of Environment		3	2
Defence/Police/Emergency Services			
Hydrology/Oceanography		6	
Meteorology/Space	1	4	
Monitoring Change		7	5
Other - Geology		1	1
Other - Ecology		1	
Other - Oil Exploration		1	
Other - Scientific Support		2	

The different sectors of the remote sensing community showed characteristically different usage patterns with educational establishments naturally rating Education/Training, Research and Consultancy as their predominant activities, generally in that order of preference in the respective categories (6, 8, 0 education; 6, 8, 0 research; 0, 6, 0 consultancy). Some research institutions maintained responsibilities in Education/Training (1,2,1) but principal activities concentrated on research (7,1,0) with less emphasis on consultancy (0, 2,1).

The interesting highlight is the broad range of applications in which most institutions were involved with only five respondents indicating total 100% activity in one particular category. Three of these were research organisations, but two private companies specified 100% activity in Manufacturing, Software and Development (Erdas UK Ltd. and Matra Marconi). Of particular activities apart from education, research and consultancy, the largest number of respondents were involved in manufacturing/software development (12) and change monitoring (12), followed by hydrology/oceanography (6). Interestingly, some categories were not indicated for any activity or applications work, namely National Survey and defence/police/emergency services - either reflecting a poor coverage or response from companies involved in this research or the lack of potential near market applications of current remote sensing technologies in these categories.

3.3 Techniques

The number of organisations indicating involvement in the following Photogrammetry and Remote Sensing techniques are listed as follows:

TABLE 3.3 Techniques:

Photogrammetry using space imaging	7
Photogrammetry using aerial photographs	12
Photogrammetry using video/scanned aerial images	6
Architectural photogrammetry	3
Archaeological photogrammetry	1
Remote sensing using space imagery	34
Remote sensing using scanned aerial imagery	22
Remote sensing using terrestrial imagery	14
Photogrammetry or remote sensing using with GIS	25
Other - Modelling	1

Many organisations indicating a primary interest in remote sensing indicated an involvement in using photogrammetric techniques, principally photogrammetry using information derived from space imagery (7), as well as more conventional approaches using aerial photographs. The development and change to digital photogrammetric systems, improved quality of colour scanner and plotters, improved software capabilities to automatically generate orthophoto products and digital terrain models and the subsequent integration of these products with remote sensing and within GIS were seen by several organisations as significant changes during the study period.

All organisations used digital remotely sensed data derived from space sensors as the fundamental basis for their activities but 65% indicated that airborne digital imagery was also used to a significant level, perhaps indicative of the increased investment by NERC in airborne technologies as well as greater levels of awareness and interest among commercial companies.

3.4 Education

The growth and awareness of remote sensing at all levels in the educational sector has continued. Increasingly, the

subject is being covered in schools at both primary and secondary levels with a surprising amount and diversity of interest being shown. Standards have also been defined in the new National Curriculum.

At undergraduate level, remote sensing is taught most commonly as part of another degree course, for example in geography, geology, environmental sciences, planetary or atmospheric physics, surveying, meteorology, or geographical information systems. Length and content of these remote sensing courses can therefore be expected to vary from course to course. In the past two years several Undergraduate Diploma and BSc Honours courses have been started which have remote sensing as the core subject. For example, the University of Greenwich (BSc) and the Bath College of Higher Education (DipHE and BSc) both offer named undergraduate degrees in remote sensing.

Courses at the postgraduate level have also increased. The Directory of UK Activities in Space Education lists 15 institutions offering diploma courses and 27 offering masters courses involving remote sensing. Principal amongst these courses are the MSc programmes offered at the Universities of London, Dundee, Aberdeen, Cambridge, Edinburgh, Silsoe College and Greenwich. Postgraduate courses in GIS, incorporating remote sensing teaching, have also increased with courses now available at Edinburgh, Nottingham, Leeds, Leicester, and UCL.

The Remote Sensing Society Special Interest Group in Education (EdSIG) has been particularly active in promoting greater dialogue between those involved and interested in teaching remote sensing at all levels in the curriculum. A regular newsletter is produced detailing activities, availability of relevant curriculum materials ranging from textbooks through teaching packs to software products. In addition, the Space Education Trust is involved in coordinating the space education activities of independent professional and non-professional organisations and has recently established a Space Education Council.

3.5 Products, Services, Facilities

Responses to facilities manufactured and supplied, provided as contract services or used internally are summarised in Table 3.4.

3.6 Research and development

There was continuing and considerable activity in all sectors of the remote sensing community. This can largely be attributed to new sources of data, a more coordinated national programme, increased participation in projects under European Union research programmes, increased focus on a multidisciplinary approach and the development of new processing techniques. The rationalisation of the national programme with research responsibilities transferred to NERC and with a coordinated approach with BNSC have already been mentioned. Several university departments reported on the development on new centres designed to increase the interdisciplinary approach to remote sensing research across their universities as well as establishing formal partnerships with overseas institutions.

TABLE 3.4 Remote sensing products, services and facilities:

Facility	Manuf. or Supply	Con-tract Service	Internal Facility
Aircraft/Space Platform	1	1	5
Air survey cameras		2	6
Terrestrial cameras			3
Other sensors - Airborne		3	6
Other sensors - Spectroradiometry	1	4	7
RS receiving stations	4	2	6
Ground control/data	4	5	15
Photographic processing	1	2	10
Image analysers	4	6	20
Stereoplotters/Comparators	1	1	5
Analytical plotters			1
Orthophotographs		2	5
Digital mapping	1	5	13
Data processing software	6	7	21
GIS/LIS user systems	2	10	22
Other - Models			2
Other - Satellite prods		1	1
Other - Training		2	1
Other - Rainfall Radar			1
Other - Software	1		
Other - SAR Processor	1	1	1

All organisations reported widespread activity geographically, centred naturally on activities in the UK, but expanding activities into Europe (24), Scandinavia (2), North America (7), South America (9), Central America (2), Asia (16), Africa (12), Former USSR (1), Middle East (6), Oceania (2), Polar (3) and Global (6).

Other developments of more strategic benefit and which were mentioned included:

- Rationalisation of NERC Airborne facility and the purchase of new digital sensors
- Integration of spatial data using GIS
- Increased quantitative applications through the use of numerical models of environmental processes
- Development and widespread use of the Internet
- An increased number of applications and products from SAR data from both space and airborne platforms (e.g. flood extent mapping, soil moisture estimation, tropical forest inventory)
- Rapid development of SAR interferometric techniques
- Development of integrated suites of image processing, GIS and stereomatching software
- Development of multisource algorithms

Applications developed and other activities during this period included:

- Environmental hazard assessment research.

- Algorithms for the estimation of evaporation from thermal images
- Offshore basin screening (oil slick mapping)
- Frequency domain SAR processor
- Use of SAR for crop yield forecasting/crop information system
- Coastal applications
- Data management techniques
- Widespread research into applications of neural nets
- Use of remotely sensed data for biodiversity studies
- ATSR-2 algorithm development projects

3.7 Significant changes in the period 1992-96

The development of coherent UK Earth Observation programme policy for research and support through the amalgamation of diverse research council remits and programmes in 1993-94 was singled out by many respondents as probably the single most significant change that has occurred during the relevant period. The increased focus on commercial development supported by successful BNSC programmes and the commercialisation of remote sensing application sales were also cited. However, whilst these developments were welcomed it was pointed out that no new money was being made available from Government to support these programmes. Of considerable concern to many respondents was the trend of declining Government research and development funding making it much harder for organisations to obtain funding to undertake original Earth Observation research.

Other trends which were noted were:

- The generally declining prices for archived satellite imagery were acknowledged as a positive development.
- Availability of ERS-1 SAR data since 1991, including development and deployment of UK developed ATSR and ATSR-2 instruments and products
- Continuing downward trend in costs and increasing sophistication of image processing software and hardware
- Increasing access to GPS technologies allowing more accurate ground control
- Spread of access to the Internet from academic and research institutions to all sectors of the community, including development of on-line image finding services.

4. THE FUTURE FOR PHOTOGRAMMETRY AND REMOTE SENSING

While the pattern of activity in both photogrammetry and remote sensing in the period 1992-96 has expanded (Table 4.1), the forecast by organisations of activities over the next period 1996-2000 shows considerable optimism, with remote sensing forecast to be the more buoyant.

Apart from the obvious continuation of existing trends, specific forecasts from organisations include:

- the development of a UK national height model
- the use of higher resolution satellite imagery
- the use of terrestrial, airborne and satellite radargrammetry
- easier use of digital systems on lower-costing hardware platforms, merging PCs and workstations
- wider acceptance and use of photogrammetry and remote sensing as tools by non-experts
- a diminishing distinction between photogrammetry and remote sensing
- the continuing integration of both technologies into GIS
- the role of AGI in facilitating the spread of information on spatial data handling.

TABLE 4.1 Present and future for photogrammetry and remote sensing:

	Photogrammetry	Remote Sensing
Status 1992-96		
Expanded	33	39
Constant	19	27
Diminished	10	5
Forecast 1996-2000		
Expand	36	54
Constant	21	15
Diminish	8	0

5. SOURCES OF INFORMATION

The Photogrammetric Record, edited by K B Atkinson, and the Photogrammetric Society newsletter, produced by D M Stirling, are the main sources of information on photogrammetric activity in the UK. A list of corporate members is published in every issue of the Record and of individual members in each April issue. The index to Vol. XIV of the Record is published in the October 1994 issue. Information about the Photogrammetric Society can also be found on its WWW pages at

(http://cesgi1.city.ac.uk/photsoc/).

The main source of information on remote sensing activity includes the Remote Sensing Society's official publications: The International Journal of Remote Sensing, edited by A P Cracknell, the Newsletter, edited by C Power and occasional monographs. Information about the Remote Sensing Society and its activities can also be found on its WWW home page:

(http://www.geog.nottingham.ac.uk/rss/top.html).

Information on access to the Society's bulletin board can also be found there. A list of corporate members is regularly published in the Society's Newsletter along with new members.

The responses to the questionnaires and related correspondence are deposited at the two Society's registered offices at UCL and at Nottingham University.