Unit 26: Geographical Information Systems in Construction

Unit code: Y/600/0390

QCF Level 3: BTEC Nationals

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit aims to give learners knowledge of the processing and application of spatial data, understanding of the interpretation of statistical data to produce maps, and to develop skills to process and present spatial data in graphical form.

Unit introduction

Advances in computer technology have introduced the concept of computer-based mapping into everyday life. The ability to analyse spatial data with a graphical output can be beneficial to developers, managers and planners operating within a competitive construction market.

Learners will gain an understanding of the various types of spatial data that are available for use within the construction sector, and will be able to identify when these systems are of benefit and how to put them to effective use.

Typical hardware and software components will be considered and applied to real and simulated projects, using software that can be found in most offices. The concepts of the layering of data, allowing the selection and presentation of relevant data only, will be addressed. The analysis of statistical data, and the use of theme maps based on this, is an integral part of the unit. Learners will be given the opportunity to apply the underpinning knowledge to a variety of tasks, using computer analysis with graphical output.

Learning outcomes

On completion of this unit a learner should:

1 Know the various types of processes and applications of spatial data

2 Understand how to interpret statistical data for use in map and computer applications

3 Be able to process spatial data and images

4 Be able to present spatial data in a graphical form.

Unit content

1 Know the various types of processes and applications of spatial data

Types of data: raster versus vector data; types of map; scales; grids; projections; scanning; digitising; field data collection and input; data formats; data storage; data transfer; transfer format

Sources of spatial data: statistical data; nationally held spatial data such as postcodes; remote sensing eg satellites, aircraft platforms, sensors, types of imagery, ground checks

2 Understand how to interpret statistical data for use in map and computer applications

Statistical data: nationally held spatial data eg local authorities, central government, census data; thematic maps

Map and computer applications: for central government; Her Majesty's Land Registry (HMLR); census data; local government eg planning, housing; Land Management Information Services (LAMIS); utilities eg gas, electricity, water, telecommunications; property gazetteers; facilities management; planning eg land use, agriculture, resources, forestry management; forecasting and monitoring changes; socio-economic applications eg targeting recipients; retail applications eg locations of retail establishments

3 Be able to process spatial data and images

Processing data and images: data retrieval from databases; database management systems; map interpretation; interpretation of statistical data; data processing; map generalisation; attribute data; monitoring of data sets; links from digital maps to databases; data editing; graphics systems; image enhancement; polygonisation; analysis of data; automated feature recognition; pattern recognition; layering of data; expert systems

4 Be able to present spatial data in a graphical form

Components: hardware eg interactive displays, hard copy devices; software; internet-based mapping websites

Graphical presentation: spatial data to be presented; components used to present data graphically

Spatial data to be presented: statistical output; products; map production; automated cartography; Ordnance Survey digital maps; data in digital form; effectiveness of different output types in sites for location finding, route planning, land use surveys

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 identify different types of spatial data [IE1, IE2, IE4, IE6, CT1]	**M1** analyse related sets of data for an area to extract relevant information	**D1** evaluate a variety of outputs from sets of data for an area
P2 describe sources of spatial data [IE1, IE2, IE4, IE6, CT1]		
P3 interpret statistical data for use in map and computer applications [IE1, IE2, IE4, IE6, CT1]		
P4 explain the applications of GIS technology [IE1, IE2, IE4, IE6, CT1]	**M2** create outputs from sets of data for an area	
P5 outline processes involved in interpreting spatial data and images [IE1, IE2, IE4, IE6, CT1]		
P6 present spatial data in a graphical format [IE1, IE2, IE4, IE6, CT1]		
P7 identify the components of computer-based systems for use in the presentation of graphical formats [IE1, IE2, IE4, IE6, CT1]	**M3** evaluate the components of a system that can deal with spatial and graphical data.	**D2** justify to a higher authority the purchase of a system that can deal with spatial and graphical data.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P8 retrieve relevant location maps from internet-based mapping websites [IE1, IE2, IE4, IE6, CT1]		
P9 present computer data in a different graphical format. [IE1, IE2, IE4, IE6, CT1]		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

Tutors can deliver this unit using a wide range of techniques. Lectures, discussions, seminar presentations, site visits, supervised practicals, research using the internet and/or library resources and the use of personal and/or industrial experience are all suitable. Delivery should stimulate, motivate, educate and enthuse learners.

This unit is intended to develop practical skills and an understanding of the principles of Geographical Information Systems (GIS). Wherever possible, the unit should be delivered with regard to individual's programmes so that assignment work, involving mainly graphic communication, can complement other specialist work.

All the learning outcomes are linked and form a logical, consistent and progressive structure. This starts by looking at the applications of GIS and the required data sets and builds on this through the computer hardware requirements of a system used to explore trends in internet mapping.

Teaching and learning strategies designed to support delivery of the learning outcomes should take an integrated, learner-centred approach. This should involve learners in collating and interpreting a variety of data sets, carrying out analyses and presenting data accordingly. This data could be extracted from existing databases, from images such as satellite or aerial photographs or from the internet.

Examples should be used continually to support the delivery process and this should always reflect real-life and standard practice. For example, interpretation of relief for road design or location of retail establishments would provide a useful learning exercise.

Wherever possible, links should be made with relevant employers, in particular the learner's employer. This will give learners the opportunity to relate to familiar areas, use them to supply suitable data and inform their study of the selection and design of the most suitable interpretation and presentation techniques.

Group activities are allowed, but tutors will need to ensure that individual learners have equal experiential and assessment opportunities.

Health, safety and welfare issues are paramount and should be reinforced through close supervision of all workshops and activity areas, and risk assessments must be undertaken before practical activities are taken. Centres are advised to read the *Delivery approach* section in the specification, and *Annexe H: Provision and Use of Work Equipment Regulations 1998 (PUWER)*.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Introduction to the unit
Demonstration of available resources
Formal delivery on types and applications of spatial data
Demonstration of availability of spatial data
Learner activity on spatial data

Topic and suggested assignments/activities and/assessment
Assignment 1: Types and Applications of Spatial Data
Visit to employer using commercial GIS Formal delivery and demonstrations on processing and presenting spatial data Learner formative activity on processing and presenting spatial data
Formal delivery and demonstrations of putting computer data in graphical form and internet-based mapping sites Learner formative activity on interpreting spatial data
Formal delivery and demonstrations on statistical data for use in map and computer applications Learner formative activity on presenting data and images
Assignment 2: Processing and Presenting Spatial Data and Images
Investigating computer systems – group work Learner formative activity on computer analysis and display
Assignment 3: Presenting Spatial Data in Graphical Forms
Review of unit and assignment feedback

Assessment

Evidence for this unit can be gathered from a variety of sources, including well-planned investigative assignments, case studies and reports of practical assignments.

There are many suitable forms of assessment that could be used, and tutors are encouraged to consider and adopt these where appropriate. Some example assessment approaches are suggested below. However, these are not intended to be prescriptive or restrictive, and are provided as an illustration of the alternative forms of assessment evidence that would be acceptable.

Some criteria can be assessed directly by the tutor during practical activities. If this approach is used suitable evidence would be observation records or witness statements. Guidance on the use of these is provided on the Edexcel website.

The structure of the unit suggests that the grading criteria may be fully addressed by using three assignments. The first of these would cover, P1, P2, M1, D1, the second would cover P4, P5, P6, M2 and the third P7, P8, P9, M3, D2.

To achieve a pass grade learners must meet the nine pass criteria listed in the grading criteria grid.

For P1, learners must identify the various types of spatial data. There is no need to describe their purpose or use at this level. Evidence could be in the form of a poster, leaflet or report.

For P2, learners must describe sources of types of spatial data identified above. This should include satellite images, aerial photographs and maps and statistical data extracted from censuses or UDPs. This should build on P1. Evidence could be in the form of a poster, leaflet or report.

For P3, learners must interpret statistical data for use in map and computer applications. Presentation is not an issue for this grade. Evidence could be in the form of a report.

For P4, learners must explain the applications of GIS technology, including the various situations where these systems would be used. Evidence could be in the form of a report, or witness statements and handouts for a presentation.

For P5, learners must outline processes involved in interpreting spatial data and images using the GIS technology explained in P4. Evidence could be in the form of a report, or witness statements and handouts for a presentation.

For P6, learners must present spatial data in a graphical format using data and images obtained by using the GIS technology explained in P4 and P5. Evidence could be in the form of a report, or witness statements and handouts for a presentation.

For P7, learners must identify the components of computer-based systems used in the presentation of graphical formats. There is no requirement for an in-depth knowledge of how each works. Evidence could be in the form of a report.

For P8, learners must retrieve relevant location maps from internet-based mapping websites. Learners must retrieve relevant location maps and/or direction finders. This would be more appropriate carried out as a class exercise, with learners working together to find the relevant information. Contributions of individual learners would need to be monitored and authenticated.

For P9, learners must present computer data in a different graphical format from that used above. Evidence could be in the form of a report.

To achieve a merit grade learners must meet all of the pass grade criteria and the three merit grade criteria.

For M1, learners must analyse related sets of data for an area to extract relevant information. This should build on the evidence provided for P1, P2 and P3 and the tutor should provide the data sets to be analysed.

For M2, learners must create outputs from sets of data for an area. This could be extended from P6 by creation of a variety of outputs for the same data.

For M3, learners must evaluate the components of a system that can deal with spatial and graphical data. They must emphasise the effectiveness and ease of use of each in a range of situations.

To achieve a distinction grade learners must meet all of the pass and merit grade criteria and the two distinction grade criteria.

For D1, learners must evaluate a variety of outputs from sets of data for an area, and report on the effectiveness of each. This could be achieved through an extension of M2 to include an evaluation of the different techniques used and their advantages and disadvantages.

For D2, learners must justify to a higher authority the purchase of a system that can deal with spatial and graphical data. Learners should describe their findings and make recommendations in the form of a report, indicating relevance to their company and/or work situation.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, M1, D1	Types and Applications of Spatial Data	Working for a consultancy company, you are asked to produce materials to promote its services to large construction companies including various types of spatial data and how this is sourced. Also, produce a report on how the GIS department interprets statistical data on maps and on computer applications.	Poster. Leaflet. Report.
P4, P5, P6, M2	Processing and Presenting Spatial Data and Images	Working in the GIS department of a construction company, you have been asked to show how spatial data can be presented.	Images. Witness statements. Presentation handouts.
P7, P8, P9, M3, D2	Presenting Spatial Data in Graphical Forms	Working in the GIS department of a construction company, you have been asked to report on the computer-based systems and internet-based mapping websites it uses.	Report to include examples of graphical presentations.

Links to other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Construction and the Built Environment sector suite. This unit has particular links with the following unit titles in the Construction and the Built Environment suite:

Level 1	Level 2	Level 3
		Surveying in Construction and Civil Engineering
		Spatial Data Techniques in Construction and Civil Engineering

This unit links to the Edexcel Level 4 NVQ in Site Inspection. It also links to the following National Occupational Standards at Level 3:

- BE Development and Control
- Spatial Data Management
- Surveying, Property and Maintenance.

Essential resources

Centres should not attempt to deliver this unit without access to a range of modern computer-based mapping packages and equipment.

Employer engagement and vocational contexts

Support to enable centres to initiate and establish links to industry, and to networks arranging visits to industry and from property practitioners is given below:

- Learning and Skills Network – www.vocationallearning.org.uk
- National Education and Business Partnership Network – www.nebpn.org
- The Royal Institution of Chartered Surveyors – www.rics.org
- Work Experience/Workplace learning frameworks – Centre for Education and Industry (CEI University of Warwick) – www.warwick.ac.uk/wie/cei/

Indicative reading for learners

Textbooks

Brewer C A – *Designing Better Maps: A Guide for GIS Users* (Environmental Systems Research Institute Press, 2005) ISBN 1589480899

Heywood I et al – *An Introduction to Geographical Information Systems, 2nd Edition* (Prentice-Hall, 2002) ISBN 0130611980

Hohl P – *GIS Data Conversion: Strategies, Techniques and Management* (Delmar, 1997) ISBN 1566901758

Mather P M and Brandt T – *Classification Methods for Remote Sensed Data* (Taylor and Francis Ltd, 2001) ISBN 0415259096

Websites

www.esri.com	GIS software
maps.google.co.uk	Google maps
www.multimap.co.uk	Multimap from Bing™
www.ordnancesurvey.org.uk	Ordnance Survey
www.streetfinder.co.uk	Street Finder

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are ...
Independent enquirers	identifying types and sources of spatial data describing applications of GIS technology based on their research
Creative thinkers	interpreting statistical data presenting data in a graphical format.

Functional Skills – Level 2

Skill	When learners are ...
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	displaying data in a graphical format
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	using location maps
Manage information storage to enable efficient retrieval	retrieving location maps
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	retrieving location maps
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	retrieving location maps
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	displaying data in a graphical format
Present information in ways that are fit for purpose and audience	displaying data in a graphical format
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	interpreting statistical data for use in map and computer applications
Identify the situation or problem and the mathematical methods needed to tackle it	interpreting statistical data for use in map and computer applications
Select and apply a range of skills to find solutions	interpreting statistical data for use in map and computer applications
Use appropriate checking procedures and evaluate their effectiveness at each stage	interpreting statistical data for use in map and computer applications
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	interpreting statistical data for use in map and computer applications
Draw conclusions and provide mathematical justifications	interpreting statistical data for use in map and computer applications

Skill	When learners are ...
English	
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	investigating the components of a GIS
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	reporting on computer-based systems.