Unit 9: Building Information Modelling and Artificial Intelligence

Delivery guidance

This unit will give learners knowledge of the collaborative capabilities of Building Information Modelling (BIM). The focus of delivery is on both developing an understanding among learners that BIM is not only about 3D drawings, but also providing them with a collaborative environment and platform where members of a project team could work together.

You could start by establishing the need for a common data environment and information exchange across various platforms. You will then follow this up with the principles and use of BIM technologies and artificial intelligence (AI) to streamline the design, construction and usage of building projects.

It is essential that learners have access to suitable BIM-enabled design and construct project case studies. This could be achieved by engaging and working with an industry partner. You will need to have expert guest speakers and should arrange visit(s) to local architectural or engineering consultancies where learners can see BIM in action and also be briefed by the industry experts as to how BIM operates.

You will demonstrate to your learners the benefits of adopting BIM as a modern method of construction and how it will support future advancements with artificial intelligence (AI). A visit to an industry exhibition where the latest technologies are showcased would reinforce in-class learning. A presentation from users or suppliers of such technologies could also be useful.

Illustrations, images, screenshots, animations, video clips and case studies are all useful resources to help explain various aspects of BIM, information exchange and AI. These resources are freely available online and can be easily incorporated into tutor presentations.

Approaching the unit

Throughout the delivery of this unit, tutors should relate the content of this unit to a number of other units on this qualification, which will help to motivate learners. These units are included at the end of this guidance. These include *Unit 1: Construction Technology*, *Unit 2: Construction Design* and *Unit 11: Management of a Construction Project*.

Tutors must provide learners with access to case studies relating to BIM-enabled projects. Links with the local industry must also be developed so that you can involve them as guest speakers and arrange visits where learners can see how BIM and AI work on a project.

Learners can be supported and challenged through a variety of means, such as knowledge quizzes, short tests, paired or group research activities, reflective accounts of any visits carried out, role plays, class discussions and presentations. This will provide opportunities for peer learning alongside motivating the learners.

Learning aim A

This learning aim is about understanding the various stages in a Digital Plan of Work (DPoW) and the information required at each stage. The focus is on what is required at each stage and its relationship with the project deliverables.

Tutors could start by introducing DPoW stages, focusing on who does what in the context of a BIM-enabled project. This could be followed by the types of information required at each stage, linking this with the project milestones. The use of project documents, screenshots, illustrations or web-based videos will help to engage learners.

Tutors could then introduce data exchange formats and how collaborative environments operate. A role play exercise and mini research activity will help learners to develop an understanding of this area.

Introduce how BIM operates at various maturity levels. Focus on the information it generates out of a digital model regarding products and assets. Engage learners by using case studies and ask them to first identify BIM maturity level requirements and then research how information generated will support the project lifecycle.

Follow this with a tutor-led research activity where learners investigate how Common Data Environment (CDE) supports the operation of a BIM-led design and construct project. Learners should be able to share results regarding types of information environments and about the currency and accuracy of the information.

Learning aim B

Tutors could adopt a holistic project-based approach for the delivery of this learning aim. Tutors could start with an introduction of Construction Operations Building information exchange (COBie) and its application in facilities management. A visit to a consulting firm or a workshop-style activity led by an industry expert will help learners to understand information types and sources. It will also help to know the information models in relation to the BIM maturity levels.

Tutors could then develop a mock project brief, allowing learners to investigate various strategies to deploy BIM, including hardware, software and available technologies.

A guest speaker could provide an example case study, demonstrating how information is controlled and security of data is guaranteed. Tutors will need to ensure that the guest speaker is from an appropriate background and that they are able to share experience of an actual project.

Learning aim C

This learning aim is about BIM and AI and their contribution towards modern methods of construction, sustainability and statutory controls.

The delivery requires documentation related to a BIM-enabled project. Learners could draw on their learning in this unit and other units, and extract the required information from project documents. Learners then could carry out research and synthesise the information on how BIM has contributed towards sustainability or how BIM could help to obtain planning permission or other required approval.

You could introduce AI by showing its application, rather than going into technical details such as machine learning. You could use videos, animations and illustrations to

demonstrate how AI is supporting modern methods of construction. A visit to an exhibition where such technologies are showcased, or a manufacturing facility where modules are being constructed, will help learners to see technologies in action.

Learning aim D

Most of this learning aim could be delivered via a visit to an architectural or engineering consultancy if an industry expert can be found to walk learners through a BIM-enabled project case study. This could cover changing roles and responsibilities, as well as working practices, due to the introduction of BIM and a DPoW.

Based on the same case study used earlier, tutors could ask learners to investigate how using BIM could improve buildability by resolving clashes early in the design process. Learners could also investigate the current legislation locally or nationally and its impact on the industry working practices.

Assessment model

Learning aim	Key content areas	Recommended assessment approach
A Examine the use of a Digital Plan of Work in an information management environment	**A1** Digital Plan of Work (DPoW) **A2** BIM and its implementation in the DPoW **A3** Common Data Environment (CDE) and the DPoW	A report showing the application of the DPoW and the support provided by the CDE in a BIM-enabled design and construct project.
B Examine the construction information management environment	**B1** Construction Operations Building information exchange (COBie) **B2** BIM deployment strategies **B3** Security of data **B4** Controlling the flow of information in a CDE	A presentation or report, showing how information flows are kept secure and how information technologies contribute to the construction environment, including how they support sustainability, statutory control, AI and use of modern methods of construction in a BIM-enabled environment design and construct project.
C Investigate the contribution of information management technologies to a BIM-enabled design and construct project	**C1** BIM and sustainability, and statutory control approval **C2** BIM, AI and modern methods of construction	
D Investigate the effect of policy, standards and legislation on the BIM-enabled environment	**D1** The DPoW and new working methods and practices **D2** BIM, buildability and working practices **D3** Industry, professional and government policies and legislation, and working practices **D4** Allocating roles and resources	A presentation or report showing the effect on a BIM-enabled design and construct project of policy and legislation application, to include roles and resources.

Assessment guidance

There is a maximum number of three summative assignments for this unit. Tutors should set the assignment briefs within the context of a BIM-enabled project. For Assignment 1, which will cover learning aim A, tutors should provide opportunities for learners to show application of the DPoW and the support provided by the CDE in a BIM-enabled project.

Learning aims B and C will be addressed in Assignment 2, and you should provide suitable context and interlink, relating to information technologies, modern methods of construction and artificial intelligence.

Assignment 3 will cover learning aim D. This should be set in the context of a BIM-enabled project and how policies and legislation could have an impact.

Tutors could ask for assessment evidence in the form of a report, reflective account, a portfolio of research activities and a presentation. Ask learners, as part of the instructions, to include screenshots, illustrations and a list of information sources used.

Getting started

Unit 9: Building Information Modelling and Artificial Intelligence

Introduction

Introduce learners to the unit using animations, screenshots, photographs, illustrations or web-based videos relating to 3D modelling and virtual environment covering various aspects of BIM, information exchange and AI.

Engage learners during the delivery of this unit through knowledge quizzes, paired or group research activities, reflective accounts of visits, role plays, class discussions and presentations

Well organised visits to a design consultancy involved with BIM-enabled projects or a technology exhibition will be invaluable to the delivery of this unit. Visits will need to be timetabled carefully to ensure that learners have sufficient knowledge across the learning aims to fully benefit from the experiences.

You will need to coordinate with the site staff to ascertain the:

- type and stage of the project
- extent to which staff could engage (project presentation, access to drawings, design data)
- intended BIM level.

Learners could prepare checklists before the visit based on their in-class activities. If arranging appropriate visits proves difficult, tutors could instead use project case studies and online resources.

Learning aim A: Examine the use of a Digital Plan of Work in an information management environment

This learning aim is about understanding the various stages in a Digital Plan of Work (DPoW) and the information required at each stage. The focus is on what is required at each stage and its relationship with the project deliverables.

Learning aim A1

- Start by introducing the DPoW stages, focusing on who does what in the context of a BIM-enabled project. Draw on learning from other units and engage through questions and answers (Q&A).
- Lead a class discussion about the types of information required at each stage of DPoW. You should make links to when data drop should take place and how this relates to various project deliverables. Use of project documents, screenshots, illustrations or web-based videos would help to engage the learners.
- Introduce the concept of collaborative working and the need to exchange data in various formats and across various platforms. You could develop a role play activity where learners act as members of the design team, client, suppliers and members of facilities management. Learners could follow this up with a research activity about data exchange formats and their role to support collaborative environments.

Learning aim A2

- Introduce BIM, how it works and what are its various maturity levels. Show them examples of virtual models focusing on the information such models generate.

Emphasise that BIM is not just about using a tool to generate 3D models, but also covers project lifecycle and helps everyone responsible for design, construction, maintenance and de-construction of an asset.

- Learners carry out research on the collaborative environment and process as an integral part of BIM implementation. Learners present their findings to the class.
- Provide learners with case studies or scenarios and ask them to identify BIM maturity level requirements and to research how information generated will support the project lifecycle.

Learning aim A3

- In a tutor-led research activity, ask learners to investigate how Common Data Environment (CDE) supports the operation of a BIM-led design and construct project. Learners will share the findings regarding types of information environments, and about the currency and accuracy of the information, with their peers.
- To review learning across the learning aim, facilitate a class discussion regarding how a DPoW works in an information management environment. Summarise learner feedback and expand on key points as necessary.

Learning aim B: Examine the construction information management environment

Learning aim B1

- Start with a tutor-led introduction of Construction Operations Building information exchange (COBie) and its application in facilities management. Draw on the learning in this unit so far and engage through Q&A.
- Arrange a visit to a consulting firm or a workshop-style day-long activity led by an industry expert. The focus of this activity is to demonstrate the benefits of COBie in the running, maintenance and repair of a building and its services. Learners would also be shown examples of various information models and sources of information in a common format. Learners should prepare checklists of any queries they have. Learners to produce a poster reflecting upon their learning during the visit or workshop session. Provide support as necessary.

Learning aim B2

- Develop an extensive group activity for learners. This could consist of various scenarios where an organisation wishes to adopt BIM at different levels of maturity and having different IT infrastructure. Learners to investigate hardware and software requirements, and explore technologies available, which would be required to deploy BIM.
- Learners will prepare posters clearly showing the requirements and providing details of suppliers and manufacturers of various kinds of hardware and software. Learners will present and justify their choices to the class. Provide support and add where necessary.
- Tutors could follow this by developing a mock project brief, allowing learners to investigate various strategies to deploy BIM including both hardware, software and available technologies.

Learning aim B3

- Invite a guest speaker from an architectural or engineering consultancy who has recent experience of working on a BIM-enabled project. The guest speaker could provide an example case study demonstrating how information is controlled and

security of data is ensured. You could help learners to access an educational version of a relevant software.

- Ask learners to work in small groups and carry out a research activity. The focus of the activity is about data protection and intellectual properties. Learners to work on an allocated topic. For example, one group could work on relevant local regulations about data protection while the other investigates what constitutes intellectual property.
- Learners share their findings in a tutor-led class discussion. Support learners during the research activity by providing a list of useful resources, summarise discussions and add extra detail where necessary.

Learning aim B4

- Arrange a visit to a design consultancy who are currently working on a BIM-enabled project or have recently completed one. The focus of this visit is for learners to develop a clear understanding of how information flows in a Common Data Environment (CDE). The consultancy staff can demonstrate how an information model operates at various work stages, who signs off the final versions and how and which data is archived.
- Learners will need to prepare themselves for the visit by drawing on prior learning in this unit, carrying out research into industry practices, developing a checklist and having questions ready for the consultancy staff.
- Learners to produce an illustration based on the visit and share an allocated aspect of information flow within CDE with the whole class. Summarise the discussion and add extra detail where necessary.

Learning aim C: Investigate the contribution of information management technologies to a BIM-enabled design and construct project

Learning aim C1

- Tutor-led presentation to recap/introduce sustainability aspects of a project as well as various statutory approvals required before a project starts. Engage learners through Q&A.
- Obtain documentation related to a BIM-enabled project. Develop a group-based activity for the learners to draw on their prior learning in this unit and other units, and extract the required information from project documents. Learners then carry out research and synthesise the information about how BIM has contributed towards sustainability of the given project. Allocate a specific sustainability requirement to each group. For example, one group is allocated materials selection while the other investigates renewable sources of energy. Each group should then present their findings to their peers in a workshop style Q&A session. Summarise key points and add detail where necessary.
- Using the same project, provide learners with an extension activity looking at how BIM could help in obtaining statutory approvals, such as planning permission. Learners can then share their findings in a Q&A session.

Learning aim C2

- Introduce/recap modern methods of construction including offsite manufacturing of building components. Lead a class discussion to establish links between BIM and the efficiencies gained in the construction processes, such as reduced time and transportation costs.

- You could introduce Artificial Intelligence (AI) by showing its application, instead of going into technical details such as machine learning. You could use videos, animations and illustrations to demonstrate how AI supports modern methods of construction.
- Introduce how Building Information Modelling (BIM) and AI help to collaborate design activities to resolve any clashes. Engage learners through Q&A and by applying learning checks through a quiz.
- A visit to an exhibition where such technologies are showcased, or an offsite manufacturing facility, will help learners to see technologies in action. Learners can prepare for the visit by developing checklists.
- After the visit, learners can produce a reflective account of their visit experience. Provide support and guidance and add detail where necessary.

Learning aim D: Investigate the effect of policy, standards and legislation on the BIM-enabled environment

Learning aim D1

- Develop a research activity for learners to carry out desk surveys about DPoW and BIM, and their influence on work methods and working practices. Following on from this, start a tutor-led class discussion asking simple questions, such as 'How has BIM changed the roles within a design team?' Summarise key points and add detail where necessary.
- Ask learners to draw on their prior learning from this unit and other units and develop a simple flow chart for the design, construction and maintenance job roles of a typical traditional construction project.
- Provide learners with details of a completed BIM-enabled project and draw their attention to information flow as well as the data 'left behind' by such a project. Learners to study the project data and compare this with a traditional construction project.
- Learners to participate in a tutor-led workshop style session discussing how responsibilities and decision-making processes have evolved. Provide support and summarise the findings.

Learning aim D2

- Using the same case study as earlier in D1, ask learners to investigate how using BIM could improve buildability by resolving clashes early on in the design process. A clash detection exercise based on the project documents will engage learners. Provide support as necessary.
- Extend this activity by asking learners to cite examples through their research where BIM has improved working practices, such as safe systems of work. Learners orally present to the class. Summarise key points and add where necessary.

Learning aim D3

- Develop a research exercise for learners after providing an overview of various stakeholders involved locally and nationally in the implementation of BIM.
- The research exercise would aim to explore how industry bodies, government policy and legislation influence BIM content and its implementation. Each group will participate in a workshop-style class discussion. Provide support, summarise key points and add detail where necessary.

Issue 1 – April 2020 © Pearson Education Limited 2020

Learning aim D4

- Arrange a guest speaker from a design management background. Alternatively, arrange a visit to an architectural or engineering consultancy where an industry expert can walk the learners through a BIM-enable project case study. This could cover the changing roles and responsibilities, as well as changing working practices, due to the introduction of BIM and a DPoW.
- Learners participate by asking relevant questions and making note of the responses. Learners reflect upon their experience during a class discussion.

Details of links to other BTEC units and qualifications and to other relevant units/qualifications

This unit links to:

- Unit 1: Construction Technology
- Unit 2: Construction Design
- Unit 11: Management of a Construction Project

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Internationals in Construction. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Chang, C. *Incentivizing Collaborative BIM-Enabled Projects: A Synthesis of Agency and Behavioral Approaches*, Project Management Institute, 2018, ISBN 9781628256239

Mordue, S., Swaddle, P. and Philip, D. *Building Information Modeling For Dummies*, John Wiley & Sons, 2015, ISBN 9781119060055

Smith, D.K., and Tardif, M. *Building Information Modeling: A Strategic Implementation Guide for Architects, Engineers, Constructors, and Real Estate Asset Managers*, John Wiley & Sons, 2009 ISBN 9780470250037

Stine, D J. *Design Integration Using Autodesk Revit 2019*, SDC Publications, 2018, ISBN 9781630571795

Videos

Go to the 'YouTube' website and search for the following videos:

'What is Building Information Modelling?'

'What is BIM? Understand Building Information Modelling'

'What happens to building information models?'

'How Building Information Modelling (BIM) is shaping the future of the UK construction industry'

Websites

National Building Specification (NBS) website – search for "What is Building Information Modelling (BIM)?"

Autodesk website – search for BIM

Designing Buildings Wiki website

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling students to access them through the school/college intranet.