Unit 15: Cloud Storage and Collaboration Tools

Delivery guidance

Cloud computing has swiftly become a key component in the infrastructure of many organisations, providing key services that support and grow their business using flexible delivery techniques and potentially involving lower start-up costs.

In this unit, learners will discover the variety of configurable computing resources, such as network devices, servers, services, storage options and applications, that run in virtual environments and can be accessed from remote locations. Where possible, they should be encouraged to explore popular commercial and freeware solutions that provide cloud-based collaboration services.

Popular uses of cloud computing include:

- IaaS (infrastructure as a service)
- PaaS (platform as a service)
- private and hybrid cloud
- big data analytics
- file storage and back-up
- disaster recovery
- test and development platforms.

To appreciate these applications and their impact on organisations, learners will develop skills that enable them to:

- explore the use of cloud technologies and tools in organisations
- design and deploy a cloud-based collaboration service to meet a client's needs
- manage and review a cloud-based collaboration service to meet a client's needs.

Links with local employers, either as real-world clients for the projects or as guest speakers, will enhance both the projects and the learner experience.

There are many opportunities for you to link and embed learning aims with other technical units (even on different vocational routes, as part of a wider learning initiative) – e.g. deploying a customised application (Unit 14) in the cloud.

If possible, create a class or course social media page, as this will allow learners to share some of their documented outcomes, as recommended in this guide and in the scheme of work.

Approaching the unit

This unit lends itself to a number of different approaches to learning, including:

- research-based investigation into how cloud-based storage and collaboration solutions are implemented in a range of organisations to fulfil different needs
- investigation of organisations that do not currently use cloud-based technologies and how their use could be implemented to fulfil the organisations' needs
- client brief-led exploration of design ideas for potential solutions to a range of problems
- practical skills-based development activities.

Delivering the learning aims

Learning aim A focuses on the use of cloud technologies and tools in organisations. Although this content is mainly theoretical, learners will benefit from exposure to real-world examples. Learners need to think about key reasons for organisations' use of cloud technologies in preference to more traditional resourcing models. Ensure learners appreciate the key characteristics of cloud computing. They should be able to identify and describe these characteristics and compare their relative benefits and drawbacks. If possible, invite a guest speaker from an organisation that uses cloud technologies, to talk to learners about the processes, decisions and considerations involved when making use of cloud technologies.

A combination of theoretical and practical approaches to learning is recommended. Theoretical learning should be varied, including discussion of different cloud computing models and supported by use of videos, presentations and animations. Use practical activities to engage learners and build the skills requires for learning aims B and C – for example, use tools such as Google's Compute Engine, Amazon Web Services, or Digital Ocean, to set up a simple IaaS solution; or create a smaller PaaS solution using software such as Kubernetes, Docker or Node.js.

Investigation of an organisation's IT requirements tends to work best when real-life case studies are involved, particularly if these studies are drawn from a local organisation where guest speakers can be invited to discuss their experiences. Case studies and guest speakers can also be useful when exploring the legal requirements to be considered when deploying cloud services and storing and using data.

Learning aim B focuses on the design and deployment of cloud technologies and tools in response to a specific client brief. This learning aim provides a simple sequence for learners to follow: plan, review, refine and develop. Learners will benefit from a real-world scenario which they can follow step-by-step from initial investigation through to final deployment. You may wish to make the problem artificially narrow, to reduce the potential complexity of the solution and ensure it is appropriate to learners' abilities. You must also ensure that, with sufficient support and scaffolding, workable solutions are possible.

Learning aim C focuses on management and review of a cloud-based collaboration service to meet a client's needs. In many respects, this is a continuation of learning aim B, moving the learner from initial deployment of the solution to ongoing management and review of cloud-based collaboration solutions.

Presentation skills form a key component of this learning aim; you may wish to deliver this content earlier in the unit, to ensure learners are fully prepared. Much of the content of this final learning aim is reflective in nature, e.g. reviewing a solution, identifying lessons learned and reviewing own skills, knowledge and behaviour.

Assessment model

Learning aim	Key content areas	Recommended assessment approach
A Explore the use of cloud technologies and tools in organisations	**A1** Cloud computing in organisations **A2** Cloud computing models **A3** IT requirements of an organisation **A4** Impact of cloud services **A5** Legal requirements	A report investigating how cloud-based storage and collaboration solutions could be implemented in an organisation to fulfil its needs.
B Design and deploy a cloud-based collaboration service to meet a client's needs	**B1** Planning cloud-based collaboration solutions **B2** Reviewing and refining designs **B3** Development of cloud-based collaboration solutions	A project brief detailing client needs, design specifications for the proposed solutions, development and testing logs, meeting notes and a report that evaluates the effectiveness and appropriateness of the cloud storage and collaboration solution.
C Manage and review a cloud-based collaboration service to meet a client's needs	**C1** Testing and maintaining cloud-based collaboration solutions **C2** Reviewing and refining cloud-based collaboration solutions **C3** Lessons learned from developing cloud-based collaboration solutions **C4** Presentation skills **C5** Reviewing own skills, knowledge and behaviours applied	

Assessment guidance

The assessment for this internally assessed unit would benefit from being divided into two assignments.

Assignment 1 (learning aim A)

This can be evidenced by a thoroughly researched report that shows an understanding of cloud technologies through analysis of a real organisation's requirements. Learners must focus on an organisation that makes limited use of cloud technologies as part of their exploration study. If the chosen organisation is local, there may be opportunities for associated activities, e.g. industrial visits and guest speakers.

To maximise their chances of success, learners should:

- use technical language fluently and appropriately in their reports
- fully understand the characteristics of a wide range of cloud technologies and delivery models, so they can effectively consider the benefits and drawbacks of each option for the organisation and its customers, staff and services
- access appropriate hardware, software and tutorials where necessary to illustrate some content
- access a range of published and online sources to provide the academic content.

Assignment 2 (learning aims B and C)

The use of a 'live' industry brief from a sponsor or mentor can provide excellent opportunities for the design and development of cloud storage and collaboration solutions. Where possible, this brief should allow learners to apply knowledge and skills from across the programme of study.

The task must involve the design and creation of a cloud storage and collaboration solution that meets the given service needs and IT requirements of a client.

To maximise their chances of success, learners should:

- provide evidence of research that is pertinent to the client brief, generating ideas that reflect the needs identified
- justify their decisions, showing a clear understanding of cloud computing models, IT requirements of the organisation and potential impacts
- review and revise their designs as necessary, justifying any decisions (or changes) made
- develop their revised designs using appropriate hardware and software tools
- document each part of the problem solving and development process, providing a detailed explanation of the tools and techniques used with a rationale for their selection
- test their final cloud-based collaboration service product, using a range of appropriate techniques, and review how closely they have met the client's original requirements.
- access appropriate hardware, software and tutorials to develop and deploy their solution
- access a range of published and online sources to provide the academic content.

You should also expect higher achieving learners to demonstrate their individual responsibility, creativity and self-management during the process.

Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 15: Cloud Storage and Collaboration Tools

Introduction

Introduce this unit by assessing learners' knowledge and experience of cloud-based storage and collaboration tools. Many learners will have used such tools and services (particularly cloud storage) via their internet connections and mobile devices, without thinking about how to install and configure them. This unit aims to illustrate the technical challenges of creating cloud-based solutions and to explain why they are becoming increasingly popular for organisations.

You could measure initial learner skills using a simple skills and behaviours audit, which will allow you to create individualised starting points based on prior experience. This will help you to manage practical sessions, spending limited support time in the most efficient manner. Repeat this process at the end of the unit, using the same document to measure learner progress.

You could also appoint (or ask for volunteers) learners with more experience to act as classroom support.

Learning aim A: Explore the use of cloud technologies and tools in organisations

A1: Cloud computing in organisations

Detail the reasons why cloud computing is used by organisations. This learning outcome could take two hours.

- Present the reasons for use and deployment of cloud technologies in organisations.
- Discuss with learners the key characteristics of cloud computing, principally on-demand self-service, ubiquitous access, resource pooling, measured service and rapid elasticity.
- Ask learners to work in small groups to debate the relative benefits and drawbacks of the key characteristics of cloud computing. Then lead a class discussion to collate feedback and conclusions from all groups.
- Invite an industry guest speaker to showcase their decision-making processes when selecting cloud-based computing solutions.
- Ask learners to summarise the points made by the industry guest speaker.

A2: Cloud computing models

Lead learners through the different cloud computing models which are available. This learning outcome could take five hours.

- Demonstrate the different types of cloud service, their characteristics, requirements and implications, e.g.
    - Software as a Service (SaaS)
    - Platform as a Service (PaaS)
    - Infrastructure as a Service (IaaS).
- Support learners in a practical activity to set up a virtualised server for PaaS and/or a cloud-based IaaS. Many cloud-based platforms (e.g. Amazon Web Services, Google's Compute Engine, DigitalOcean) offer free trials or a free tier for small-use cases. These large

commercial platforms are often well-documented and provide a good introduction to the potential of cloud-based servers. This can be simulated locally, to a degree, via virtualised servers using software such as Oracle's VM VirtualBox. Classroom-capable mini-PaaS solutions can be created using combinations of software such as HashiCorp's Vagrant and Docker. Note: This is just a recommendation, as this unit does not recommend any particular technology.

- Discuss the link between virtualisation and cloud services.
- Ask learners to create a poster/wiki/infographic/podcast which details the characteristics, requirements and implications of the four different cloud delivery models (community, hybrid, private and public).
- Compare and contrast self-hosting versus third-party services.
- Discuss automation, cloud bursting, JIT (just in time) service and multi-tenancy issues.

A3: IT requirements of an organisation

Demonstrate (where possible) and discuss how cloud computing can fulfil the IT requirements of an organisation. This learning outcome could take four hours.

- For a given case study (ideally from local industry), detail an organisation's current IT systems.
- Ask learners to work in pairs to identify the services the organisation provides and, for each service, to show how cloud services could support them (e.g. secured cloud back-up of confidential client data).
- Lead a class discussion about customers' needs, expectations and how the service delivery model could be affected by a move to a cloud-based solution.
- Ask learners to work in small groups to identify how a cloud-based solution could alter or impact job requirements, accessibility issues, working styles and working patterns.
- Discuss how the service delivery point may change.
- Ask learners to consider legal and ethical concerns (e.g. licensing, security and privacy) when considering a move to cloud-based solutions. This may require integration of learning aim A5, so learners understand the legal implications more fully before beginning this task.

A4: Impact of cloud services

Explore the impact of cloud services. This learning outcome could take three hours.

- Present the implications of cloud computing services and solutions for:
    - individuals, e.g. flexibility, cost, efficiency, uses and applications, risks and challenges
    - organisations, e.g. user experience, staffing issues, back-up and disaster recovery, legal ownership of data and dispute resolution.
- Ask learners to research the impacts of cloud services, considering hardware, software and communication resources. These impacts can be discussed in purely monetary terms. Also encourage learners to explore less tangible but equally important concerns, such as staff issues, and legal and ethical constraints.
- If possible, invite guest speakers with first-hand experience of the issues and impacts of cloud technologies. This will help learners to explore issues that may not be obvious at first.
- Ask learners to summarise the key facts from your presentation in a one-page fact sheet that could be issued to local organisations considering cloud-based solutions.
- Ask learners to investigate and discuss issues related to data and processing in regions that may not have appropriate laws covering protection and use of data.

A5: Legal requirements

Detail the current and relevant legal requirements in your region, and consider appropriate international laws, that impact the planning, use and deployment of cloud services by organisations. This learning aim should take approximately four hours.

- Present a summary of the relevant legislation and its key principles, making explicit links to pertinent issues, e.g. privacy, security, intellectual property etc.
- Generate learner-driven group or round-table discussion using relevant case studies.
- If possible, arrange a classroom 'court' with learners role playing various parts (defendant, prosecution, defence, jury and expert witnesses) while you act as the judge. This approach can be particularly effective when paired with the legal frameworks relevant to this subject (see specification).

Learning aim B – Design and deploy a cloud-based collaboration service to meet a client's needs

B1: Planning cloud-based collaboration solutions

Detail the documentation learners need to generate to plan and implement a cloud-based collaboration solution, using current applicable technologies. Learning aim B1 should take approximately five hours.

- Start by walking learners through a model set of documentation produced for a client brief. You could also share previously completed learner work; this is often very illuminating and can help to set the standard for new learners.
- Demonstrate the different elements that form a design's documentation, e.g. purpose of solution, client's requirements, user needs, technical requirements, risk and mitigation.
- Provide guidelines for documentation elements such as hardware and software requirements, specifically those that constitute the desired infrastructure.
- Discuss legal and ethical requirements that should be included, e.g. potential data protection concerns, copyright acknowledgements and consideration of ethical issues. Use examples where such issues were not considered thoroughly and the resulting product received legal, public or critical backlash.
- Encourage learners to consider and discuss technical constraints that may limit the potential solution.
- Using sample client briefs, allow learners to solve problems and design solutions within a set time limit, after which they can present their efforts.

B2: Reviewing and refining designs

Help learners to review and refine their designs by introducing the process of working with clients and others to improve their quality, effectiveness and appropriateness. Learning aim B2 should take approximately five hours.

- Ensure learner communication skills are at the appropriate level before tackling this outcome. This should include all popular forms of communication, e.g. letter, email, telephone call, voice or video conferencing and personal interview. Place additional emphasis on non-verbal communication, especially when learners are receiving feedback from clients. Note: This may require integration of learning aim C4, although this content is likely to have been covered during other units in this programme of study.
- Discuss techniques for gathering feedback from clients and users, e.g. email, interview, surveys, monitoring social platforms and usability tests. Where possible, clients should not be directly associated with the programme; internal clients from within the institute are an

acceptable substitute. Social media is a good way to engage with local organisations to find suitable learner-friendly client briefs.

- Arrange, moderate and support client–learner role to encourage learners to accept constructive feedback from stakeholders and refine their designs accordingly.
- Demonstrate how timescales can be renegotiated and adjusted as ideas and solutions are refined based on feedback and updated designs.
- Ask learners to update their design specifications based on the feedback received. Review the changes made.

B3: Development of cloud-based collaboration solutions

Support learners to implement cloud-based collaboration solutions to meet identified requirements. Learning aim B3 should take approximately twenty hours.

- Demonstrate how to:
    - prepare the physical system/virtual infrastructure
    - prepare the platform, e.g. guest OS image and allocation of host computer resources (hard disk, RAM etc.)
    - add, remove and update software, services and tools as specified
    - perform user management
    - prepare cloud clients
    - manage an effective collaboration
    - produce detailed documentation of the development process, i.e. how it was achieved.

  As previously discussed, most of these preparations and actions can be performed using actual cloud-based services or simulated through virtualised servers. Where possible, specific and measurable goals should be linked to these preparations; learners should remember why the cloud solution is being created and what services it is expected to provide.
- Ask learners to work in small groups of three or four to repeat the process, logging their own actions and findings as they progress. Provide differentiated support and problem solving as required.

Learning aim C: Manage and review a cloud-based collaboration service to meet a client's needs

C1: Testing and maintaining cloud-based collaboration solutions

Facilitate learners' ability to test and maintain cloud-based collaboration solutions. Learning aim C1 should take approximately three hours.

- Set learners a pair-based task that asks them to investigate different types of testing, e.g. functional, user, performance, stress and security.
- Ask learners to share and collate their findings with their peers.
- Demonstrate the typical stages of testing, e.g.
    - selecting suitable test users
    - gathering feedback from users
    - producing appropriate test documentation
    - making use of testing outcomes
    - performing continued maintenance.

- Select a suitable cloud-based solution and ask learners to apply suitable testing techniques to ascertain whether it meets the client's identified requirements. Discuss learner findings.

C2: Reviewing and refining cloud-based collaboration solutions

Detail the desired workflow associated with monitoring the performance of cloud-based solutions and making updates and changes as needed. Learning aim C2 should take approximately three hours.

- Ask learners to identify potential security issues and updates, particularly through the identification of potential threats and breaches. Use a suitable (and well-known) case study – for example, the panic faced by system administrators world-wide when the Heartbleed Bug was documented in 2014 (CVE-2014-0160) and the measures that were applied to identify and patch the vulnerability.
- Demonstrate how to install software updates for operating systems (using multiple operating systems) and applications.
- Demonstrate how to address compatibility issues.
- Discuss how to deal with changing user requirements, e.g. adding a new functionality to a cloud service (such as a relational database, web server, code frameworks etc.).
- Debate support for different interface/input methods.
- Support learners in a range of practical activities to review and refine cloud-based services on a virtualised server for PaaS and/or a cloud-based IaaS.

C3: Lessons learned from developing cloud-based collaboration solutions

Help learners to evaluate the effectiveness of cloud-based collaboration solutions. Learning aim C3 should take approximately two hours.

- You could start by sharing a relevant case study and asking learners to create a document (manual or electronic) that will allow them to record the information required to evaluate the effectiveness of the solution. Then guide learners to evaluate their own deployment activities.
- During evaluations, learners should consider these key questions:
    - How well does the solution match the identified client's requirements?
    - How efficient is the solution?
    - How easy to use is the solution?
    - Did any issues arise during testing and maintenance, e.g. bugs, identified vulnerabilities?
    - How stable is the solution? (Consider connectivity and loss of service.)
    - What is the potential update schedule?
    - How could the implemented solutions be improved?
    - What alternative solutions could be implemented if the brief was reattempted?
- Ask learners to present their findings to their peers and to give constructive feedback on each other's ideas.

C4: Presentation skills

Encourage learners to think about (and practise) their presentation skills. Learning aim C4 should take approximately two hours. You could ask a communications specialist to deliver this topic.

- Discuss and demonstrate the following communication skills using a variety of scenarios and physical surroundings (including online):

- written styles including email, design documentation, recording documentation, reports and visual aids for presentation use
- verbal communication requirements, including one-to-one and group informal and formal situations
- use of tone and language for verbal and written communications to convey intended meaning
- strategies to make a positive and constructive impact on audience, e.g. positive and engaging tone, technical and vocational language suitable for intended audience, avoidance of jargon
- how to respond constructively to the contributions of others.

- Give learners opportunities to practise a range of communication activities including:
  - writing formal reports
  - writing informal emails
  - presenting (to peers, guests etc.)
  - leading a discussion (role play etc.)
  - leading a formal meeting (role play etc.).
- Identify strengths and areas for improvement for each learner.
- If possible, repeat activities over time (e.g. rotating leadership in group discussions during a topic) and identify whether learners have improved.

C5: Reviewing own skills, knowledge and behaviours applied

Help learners to reassess their professional behaviours, such as etiquette, teamwork and leadership. Learning aim C5 should take approximately two hours.

- Reissue the skills and behaviours audit completed by learners in the first session. Ask them to complete the audit again and make additional observations about where and how they feel they have improved. Learners may find it useful to reference their ILPs when completing this task.
- Ask learners to use the internet (or the centre's own learning centre resources) to identify sources such as videos or other materials that could help them to improve the skills they identified as needing improvement. Collate a list of resources from all learners to be published and/or shared by the class.

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

This unit links to:

- Unit 1: Information Technology Systems
- Unit 2: Creating Systems to Manage Information
- Unit 6: Website Development
- Unit 11: Cyber Security and Incident Management
- Unit 12: IT Technical Support and Management
- Unit 13: Software Testing
- Unit 14: Customising and Integrating Applications.

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 Information Technology. Check the Pearson website at http://qualifications.pearson.com/endorsed-resources for more information as titles achieve endorsement.

Textbooks

- Barnatt, C., *A Brief Guide to Cloud Computing: An essential guide to the next computing revolution*, Robinson Press, 2010, ISBN 978-1-849-01406-9 – This publication not only considers where cloud computing is now, but also makes some interesting predictions about the implications of cloud computing in the future.
- Cohen, M., Hurley, K. and Newson, P., *Google Compute Engine*, O'Reilly Media, 2015, ISBN 978-1-449-36088-7 – An introductory text that considers the basics while also providing some coding examples.
- Crookes, D., *Cloud Computing in Easy Steps*, Easy Steps Limited, 2012, ISBN 978-1-840-78532-6 – This is essentially a 'how to' book. It is not targeted at advanced developers but does explain some of the familiar concepts (such as SkyDrive, Dropbox and Apple iCloud) in a way that is easy to access by a wide variety of learners.
- Kavis, M., *Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)*, John Wiley & Sons, 2014, ISBN 978-1-118-61761-8 – This book provides some interesting perspectives on what to look for (and what to avoid) when moving from a physical to a cloud architecture, and also gives a solid introduction to the concepts of cloud computing.
- Williams, M., *A Quick Start Guide to Cloud Computing: Moving your business into the cloud*, Kogan Page Limited, 2010, ISBN 978-0-749-46130-0 – A good publication for jargon busting with some coverage of risk and some useful case studies around SaaS, PaaS and IaaS

Journals

- *Cloud Computing Intelligence (CCi) (Future Publishing)*
- *Cloud Computing Magazine*
- *IEEE Cloud Computing*

Videos

You may wish to search YouTube for the following titles:

- *Cloud Computing: What is Cloud Computing?*
- *Changes to computer thinking – Stephen Fry explains cloud computing*
- *The Three Ways to Cloud Compute*
- *Google Compute Engine – Ten Minute Test Drive: Set Up your own Web Server*
- *Cloud Wars: Amazon (AWS) vs. Google (GCP) vs. Microsoft (Azure) | CBT Nuggets*

Websites

- *Google Cloud Platform – Google Compute Engine delivers virtual machines running in data centres and across a worldwide fibre network.*
- *Common Vulnerabilities and Exposures (CVE) – This website provides an online dictionary of publicly-known information security vulnerabilities and exposures.*
- *Docker – This is a popular software containerisation platform for easier deployment in smaller PaaS solutions.*
- *The Tech Partnership – A network of employers working to create skills for the UK's digital economy.*
- *Vagrant by HashiCorp – Create and configure lightweight, reproducible and portable development environments as might be used in smaller PaaS solutions.*
- *Oracle VM VirtualBox – A powerful ×86 and AMD64/Intel64 virtualisation product for enterprise as well as home use.*

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 learners to access them through the school/college intranet.