# Pearson BTEC Nationals in Information Technology

## Delivery Guide

Pearson BTEC Level 3 National Certificate in Information Technology

Pearson BTEC Level 3 National Extended Certificate in Information Technology

Pearson BTEC Level 3 National Foundation Diploma in Information Technology

**First teaching 2016**

Pearson BTEC Level 3 National Diploma (2017) in Information Technology

Pearson BTEC Level 3 National Extended Diploma (2017) in Information Technology

**First teaching 2017**

**Edexcel, BTEC and LCCI qualifications**

Edexcel, BTEC and LCCI qualifications are awarded by Pearson, the UK's largest awarding body offering academic and vocational qualifications that are globally recognised and benchmarked. For further information, please visit our qualification websites at www.edexcel.com, www.btec.co.uk or www.lcci.org.uk. Alternatively, you can get in touch with us using the details on our contact us page at qualifications.pearson.com/contact us

**About Pearson**

Pearson is the world's leading learning company, with 40,000 employees in more than 70 countries working to help people of all ages to make measurable progress in their lives through learning. We put the learner at the centre of everything we do, because wherever learning flourishes, so do people. Find out more about how we can help you and your learners at qualifications.pearson.com

# Welcome to your BTEC National delivery guide

This delivery guide is a companion to your BTEC Level 3 National specifications, Authorised Assignment Briefs (AABs) and Sample Assessment Materials (SAMs). It contains ideas for teaching and learning, including practical activities, realistic scenarios, ways of involving employers in delivery, ways of managing independent learning and how to approach assessments. The aim of this guide is to show how the specification content might work in practice and to inspire you to start thinking about different ways to deliver your course.

The guidance has been put together by tutors who have been close to the development of the qualifications and so understand the challenges of finding new and engaging ways to deliver a BTEC programme in the context of the new qualifications from 2016 and 2017.

Guidance around what you will need to consider as you plan the delivery of the qualification(s) has been provided. You will find information around the structure of your course, how you may wish to build the course for your learners, suggestions for how you could make contact with employers and information around the other support and resources available to you.

Unit-by-unit guidance has been provided, which includes suggestions on how to approach the learning aims and unit content, as well as ideas for interesting and varied activities. You will also find coverage of assessments, including useful advice about external assessment, as well as tips and ideas around how to plan for and deliver your assignments.

You will also find a list of carefully selected resources for each unit. The lists include suggestions for books, websites and videos that you can either direct your learners to use or that you can use as a way to complement your delivery.

We hope you will find this guidance relevant and useful.

Enjoy your course!

### What's new

The BTEC Level 3 Nationals 2016 and 2017 are the result of more than three years' consultation with employers, higher education institutions, and many thousands of tutors and managers in colleges and schools. Our aim has been to ensure that the BTEC Level 3 Nationals continue to allow a recognised and well-respected route into employment or higher education by meeting the needs of these key stakeholders, and that learners continue to enjoy a stimulating course of study and develop the skills and attributes that will enable them to progress.

As a result of this consultation, and on the advice of employers, higher education institutions and most importantly of those of you who teach BTEC, some key changes have been made to the BTEC Level 3 Nationals. These are described throughout this delivery guide and include the following:

- **Updated content and a larger proportion of mandatory content** – both employers and universities said they wanted a greater consistency in coverage of the subject for BTEC learners. Employers wanted to see systematic coverage of core knowledge and skills for their sector, and for the Nationals to reflect up-to-date industry practice.

- **The reintroduction of external assessment** – employers were keen to see an element of rigour and consistency across the country in terms of assessment, while higher education institutions wanted learners to be better prepared for meeting deadlines and preparing for formal exams, where appropriate. Both were keen to see learners applying their knowledge and skills to new contexts through synoptic projects and assessments.

- **A focus on employability skills** – the BTEC approach to learning, through projects, practical assignments, group work and through simulating the world of work, has always supported the development of employability skills, e.g. self-management. In the new

Nationals, the balance of cognitive and skills work has been carefully calibrated to ensure that learners get a range of different opportunities across their course.

- **Broader assessment in internal units** – the assessment criteria for each unit are carefully structured to set a clear level of demand. Distinction criteria encourage and require depth of study, including demonstration of the application of knowledge and understanding as well as a synoptic element for the learning aim or unit.

- **Alignment with DfE criteria for performance measures for 16–19 year olds in England** – all new BTECs are designed as either Applied General qualifications or Tech Levels to fulfil criteria for inclusion in 2018 performance tables and funding for 16–19 year olds and 19+ learners.

To support transition to the BTEC Level 3 Nationals 2017, we are providing an enhanced support programme with exemplar and practice materials and training. Please see the *Support and resources* section for details of this support, and the link to sign up for tutor training, which continues throughout the lifetime of the qualification.

**Notes:**

The specification tells you what **must** be taught and what **must** be assessed. This delivery guide provides suggestions and ideas on how you could do this.

The suggestions given in this delivery guide link with the Authorised Assignment Briefs provided by Pearson, but they are not compulsory. They are designed to get you started and to spark your imagination.

# Contents

# OVERVIEW

## Delivery Guides as support

In the specification, the 'Unit content' tells you what must be taught and the 'Assessment criteria' what must be assessed. The 'Essential information for assessment decisions' explains what the assessment criteria mean.

This delivery guide provides suggestions and ideas on how to plan and deliver the qualification, and includes a summary of recent changes.

Unit-by-unit guidance has been provided, which includes suggestions on how to approach the learning aims and unit content. Teaching, learning and formative assessment activities are also suggested. You will also find delivery plans to help you timetable your course and ensure that your learners are well prepared for internal and external assessments.

Links to carefully selected resources are provided for each unit. The lists include suggestions for books, websites and videos, which will help you plan and deliver your course. Alternatively, you may wish to direct your learners to these resources.

Use the delivery guides as model templates or an interpretation on which you can base your own plan. Every delivery guide presents each unit as an exemplar, highlighting IT links to motivate tutors and learners.

## Significant changes for those teaching to the new 2017 specification

The BTEC Level 3 Nationals 2017 contain significant changes to the previous 2010 version. These changes reflect the views and demands of IT teaching practitioners, those working in the IT sector and government bodies with oversight of the qualifications.

For those familiar with the older 2010 specification, these changes are summarised in the table below:

| Change | New 2017 | | Old 2010 | |
|---|---|---|---|---|
| Programme Name | Information Technology | | Information Technology | |
| Qualification Names/GLH | Certificate 180 GLH | | Certificate | 180 GLH |
| | Extended Certificate | 360 GLH | Subsidiary Diploma | 360 GLH |
| | Foundation Diploma | 510 GLH | 90 – credit Diploma | 540 GLH |
| | Diploma | 720 GLH | Diploma | 720 GLH |
| | Extended Diploma | 1080 GLH | Extended Diploma | 1080 GLH |
| Mandatory Units | Between 1 and 7 dependent on qualification | | Between 2 and 6 dependent on qualification | |
| Optional Units | Choose from up to 14 dependent on qualification | | Choose from up to 40 dependent on qualification (and pathway) | |
| Assessment | Internal through assignment and up to 4 External depending on qualification | | Internal only through assignments | |

## Structure

The table below shows the structure of the qualifications in the Information Technology suite of qualifications.

By a clear understanding of the units and careful selection, centres can tailor the qualification to suit the needs of their learners and the resources of the centre.

| Unit (number and title) | Unit size (GLH) | Certificate (180 GLH) | Extended Certificate (360 GLH) | Foundation Diploma (510 GLH) | Diploma (720 GLH) | Diploma Extended (1080 GLH) |
|---|---|---|---|---|---|---|
| 1 Information Technology Systems | 120 | | M | M | M | M |
| 2 Creating Systems to Manage Information | 90 | M | M | M | M | M |
| 3 Using Social Media in Business | 90 | M | M | M | M | M |
| 4 Programming | 90 | | | M | M | M |
| 5 Data Modelling | 60 | | O | O | O | O |
| 6 Website Development | 60 | | O | O | O | O |
| 7 Mobile Apps Development | 60 | | | O | O | O |
| 8 Computer Games Development | 60 | | | O | O | O |
| 9 IT Project Management | 90 | | | | M | M |
| 10 Big Data and Business Analytics | 60 | | | | O | O |
| 11 Cyber Security and Incident Management | 120 | | | | M | M |
| 12 IT Technical Support and Management | 60 | | | | O | O |
| 13 Software Testing | 60 | | | | O | O |
| 14 IT Service Delivery | 120 | | | | | M |
| 15 Customising and Integrating Applications | 60 | | | | O | O |
| 16 Cloud Storage and Collaboration Tools | 60 | | | | O | O |
| 17 Digital 2D and 3D Graphics | 60 | | | | O | O |
| 18 Digital Animation and Effects | 60 | | | | O | O |
| 19 The Internet of Things | 60 | | | | O | O |
| 20 Enterprise in IT | 60 | | | | O | O |
| 21 Business Process Modelling Tools | 60 | | | | O | O |

Pearson BTEC Nationals in Information Technology – Delivery Guide
Issue 1 – November © Pearson 2017

# Overview of the IT qualification suite

One of the key factors in the development of this suite was to ensure that confidence in the BTEC IT suite was maintained and endorsement from both higher education and employers is a reflection of the confidence that stakeholders have in these qualifications. This is supported by the continued allocation of UCAS points.

Offering these qualifications at different sizes makes them a flexible option, particularly alongside other programmes such as A levels or Tech Levels/Applied Generals in other subject areas.

The introduction of external assessment is a positive step in improving quality as well as the learner experience. This is particularly true in the IT sector as learners who choose to work in this sector may well continue to study for professional qualifications that lead to vendor certification and where examinations or other forms of external assessment are the norm.

In addition, the formalisation of synoptic assessment (which has been in evidence in many centres as good practice for years) sees an end to units being taught in isolation. Learners will be able to see the connections between prior and current learning, drawing on all their developed knowledge and skills to solve IT problems.

## Certificate

This qualification is designed for learners who are interested in a basic introduction to the study of IT alongside other fields of study, with a view to progressing to a wide range of higher education courses, not necessarily in IT.

## Extended Certificate

This qualification is designed for learners who are interested in an introduction to the study of creating IT systems to manage and share information, alongside other fields of study, with a view to progressing to a wide range of higher education courses, not necessarily in IT.

## Foundation Diploma

This qualification is designed to support learners who wish to study IT as a one year, full-time course, or for those wishing to take it alongside another area of complementary or contrasting study as part of a two-year, full-time study programme. If taken as part of a programme of study that includes other appropriate BTEC Nationals or A levels, it supports progression to higher education.

## Diploma

The qualification is designed to be studied over two years and carries UCAS tariff points. It meets entry requirements in its own right for some courses in information technology or related study such as an HNC or HND in Computing, Engineering or Business Management. For progression to a degree course, learners should normally study this qualification alongside other qualifications, such as an A level or BTEC Extended Certificate in a different or complementary subject area.

## Extended Diploma

The qualification is designed to be studied over two years and carries UCAS tariff points. It fully meets entry requirements for progression to a degree course in information technology and related areas such as Digital Technology Solutions, IT Management for Business, Computer Networks Security or Business Computing and Entrepreneurship.

## BTEC Level 3 National Certificate

The BTEC Level 3 National Certificate may be delivered as a part-time standalone course, possibly delivered alongside other Level 3 BTECs or A levels, for example, with Maths and/or English Level 2.

There are two units for the National Certificate, both of which are mandatory:

- Unit 2 is externally set and examined (synoptic unit)
- Unit 3 is internally set and assessed. There are no other units in this qualification.

It is likely that this 180 GLH qualification will be delivered in one year.

### Mandatory units

### External units

*Unit 2: Creating Systems to Manage Information* is a mandatory, externally assessed unit. Centres should concentrate on the necessary underpinning knowledge found within Unit 2 in the Autumn term to enable learners to begin the internally assessed unit towards the end of the Autumn term and through the Spring term, picking up the remaining learning and focusing on synopticity in anticipation of the examination in June.

### Internal units

*Unit 3: Using Social Media in Business* is a mandatory, internally assessed unit. This would be best delivered short and fat in the late Autumn and Spring terms, allowing learners to focus on their assignments ahead of the standards verification in a timely manner and provide them ample time to revisit Unit 2 in preparation for that examination in June.

## BTEC Level 3 National Extended Certificate

The BTEC Level 3 National Extended Certificate is designed as a one-year, full-time course or as part of a two-year, full-time programme with opportunity for inclusion of other BTEC National Level 3 courses or A levels. It consists of three mandatory and two optional units.

There are three mandatory units for the Foundation Diploma:

- Unit 1 is externally set and examined (synoptic unit)
- Unit 2 is externally set and examined
- Unit 3 is internally set and assessed.

In addition, one optional unit must be delivered and assessed.

The choice of when each unit is delivered will be determined by the mode of study – in other words, whether it is a one-year or a two-year programme.

If this is being studied as a one-year programme, it is essential for Units 1 and 2 to be delivered first to ensure that learners can be ready to take assessment where relevant in the examination series. There is more flexibility if studied over two years as Year 1 would naturally lend itself to Units 2 and 3, allowing learners a fall back option of the Certificate after one year. This also allows for the internal and external assessment to be split over the two years. As this qualification should be taught practically, there should be ample opportunity for practical work that can be formally assessed during Year 1.

**Mandatory units**

**External units**

Assessment opportunities for *Unit 1: Information Technology Systems* and *Unit 2: Creating Systems to Manage Information* are offered in both the January and June series.

Delivered over 2 years, Unit 2 would also benefit from a more staggered delivery approach but, if being studied over one year, it would be necessary to use a 'short and fat' approach, with delivery in the Autumn term and assessment in the January series, allowing learners a resit opportunity, if necessary, in the June series.

Unit 1 is mandatory and it is suggested that it is delivered using a 'long and thin' approach, alongside other units. Learners following a two-year course would have multiple opportunities for entry in January and June and, if necessary, multiple resit opportunities.

The more staggered approach would also give centres the opportunity to build in examination preparation time, once internally assessed units have been completed.

**Internal units**

It would probably be best to deliver *Unit 3: Using Social Media in Business* 'short and fat' in the Autumn/Spring terms. This would help ensure that the assignments are available for standards verification in a timely manner. It would also mean that learners would benefit from a more focused experience that will build skills quickly.

**Optional units**

Learners must choose one optional unit from *Unit 5: Data Modelling* or *Unit 6: Website Development*.

It would probably be best to deliver these optional units 'short and fat' in the Autumn/Spring term if learners are following a one-year course. This would help ensure that the assignments are available for standards verification in a timely manner. It would also mean that learners would benefit from a more focused experience that will build skills quickly. However, learners on a two-year course may benefit from delivery of these units in the Summer term. This could give learners longer to embed and practise the skills.

## BTEC Level 3 National Foundation Diploma

The BTEC Level 3 National Foundation Diploma is designed as a one-year, full-time course or as part of a two-year, full-time programme with opportunity for inclusion of other BTEC National Level 3 courses or A levels. It consists of four mandatory and four optional units.

There are four mandatory units for the Foundation Diploma:

- Unit 1 is externally set and examined
- Unit 2 is externally set and examined
- Unit 3 is internally set and assessed
- Unit 4 is internally set and assessed (synoptic unit).

In addition, two optional units must be delivered and assessed.

**Mandatory units**

**External units**

Assessment opportunities for *Unit 1: Information Technology Systems* and *Unit 2: Creating Systems to Manage Information* are offered in both the January and June series.

Unit 1 is mandatory and it is suggested that it is delivered from the start of the course and spread across the whole programme so that it can be taught alongside other units. Learners following a two-year course would have multiple opportunities for entry in January and June and, if necessary, multiple resit opportunities. This 'long and thin' approach would also give

centres the opportunity to build in examination preparation time, once internally assessed units have been completed.

Delivered over 2 years, Unit 2 would also benefit from a staggered, longer delivery approach but, if being studied over one year, it would be necessary to use a 'short and fat' approach, with delivery in the Autumn term and assessment in the January series, allowing learners a resit opportunity, if necessary, in the June series.

### Internal units

It would probably be best to deliver *Unit 3: Using Social Media in Business* in the Autumn/Spring terms. This would help ensure that the assignments are available for standards verification in a timely manner. It would also mean that learners would benefit from a more focused experience that will build skills quickly.

As the synoptic unit, *Unit 4: Programming* should be delivered 'long and thin' to allow learners to acquire additional skills so that they have a wider skills and knowledge base before the assessment process.

### Optional units

Learners must choose two optional units from *Unit 5: Data Modelling*, *Unit 6: Website Development*, *Unit 7: Mobile Apps Development* or *Unit 8: Computer Games Development*.

It would probably be best to deliver these optional units 'short and fat' in the Autumn/Spring term if learners are following a one-year course. This would help ensure that the assignments are available for standards verification in a timely manner. However, learners on a two-year course may benefit from delivery of these units in the Summer term. Again, it would also mean that learners would benefit from a more focused experience that will build skills quickly.

## BTEC Level 3 National Diploma

The BTEC Level 3 Diploma is designed to be studied over two years and carries UCAS tariff points. It meets entry requirements in its own right for some courses in IT or related study such as an HNC or HND in Computing, Engineering or Business Management. For progression to a degree course, learners should normally study this qualification alongside other qualifications, such as an A Level or BTEC Extended Certificate in a different or complementary subject area.

The diploma is made up of eight units of which six are mandatory. Of the six mandatory units:

- Unit 1 is externally set and examined
- Unit 2 is externally set and examined
- Unit 3 is internally set and assessed
- Unit 4 is internally set and assessed
- Unit 9 is internally set and assessed
- Unit 11 is externally set and examined.

In addition, two optional units must be delivered and assessed.

Assessment opportunities for *Unit 1: Information Technology Systems* and, *Unit 2: Creating Systems to Manage Information* and *Unit 11: Cyber Security and Incident Management* are offered in both the January and June series.

Unit 1 is mandatory and it is suggested that it is delivered from the start of the course, across the whole programme so that it can be taught alongside other units. Learners following a two-year course would have multiple opportunities for entry in January and June and, if necessary, multiple resit opportunities. This 'long and thin' approach would also give centres the opportunity to build in examination preparation time, once internally assessed units have been completed.

Delivered over 2 years, Unit 2 would also benefit from a 'long and thin' approach but, if being studied over one year, it would be necessary to use a quicker, more concentrated approach, with delivery in the Autumn term and assessment in the January series, allowing learners a resit opportunity, if necessary, in the June series.

Given the synoptic Nature of Unit 11, this would benefit from a long and thin approach to ensure learners have covered enough of the content to satisfy the assessment of the unit. If being studied over one year, it would be necessary to use a 'short and fat' approach, with delivery in the Autumn term and assessment in the January series, allowing learners a resit opportunity, if necessary, in the June series.

### Internal units

It would probably be best to deliver *Unit 3: Using Social Media in Business* in the Autumn/Spring terms. This would help ensure that the assignments are available for standards verification in a timely manner. It would also mean that learners would benefit from a more focused experience that will build skills quickly.

Units 4 and 9 could also be delivered 'short and fat' to ensure all criteria are covered ready for the assessment of the synoptic unit. A more staggered delivery approach can also be taken for two-year delivery as long as adequate planning has taken place to ensure learners have developed the knowledge requirements for the external synoptic assessments.

### Optional units

Learners must choose two optional units from a list of 14 available units (full list available at http://qualifications.pearson.com/content/dam/pdf/BTEC-Nationals/Information-Technology/2016/specification-and-sample-assessments/9781446939505-BTEC-NAT-L3-DIP-IT-SPEC-PREPUBv4.pdf).

It would probably be best to deliver these optional units 'short and fat' in the Autumn/Spring term if learners are following a one-year course. This would help ensure that the assignments are available for standards verification in a timely manner. However, learners on a two-year course may benefit from delivery of these units in the Summer term. Again, it would also mean that learners would benefit from a more focused experience that will build skills quickly.

## BTEC Level 3 National Extended Diploma

The BTEC Level 3 Extended Diploma programme is designed to be studied over two years and carries UCAS tariff points. It fully meets entry requirements for progression to an IT-related degree programme.

It is made up of 13 units of which 7 are mandatory. Of the 7 mandatory units:

- Unit 1 is externally set and examined
- Unit 2 is externally set and examined
- Unit 3 is internally set and assessed
- Unit 4 is internally set and assessed
- Unit 9 is internally set and assessed
- Unit 11 is externally set and examined
- Unit 14 is externally set and examined.

In addition, six optional units must be delivered and assessed.

Assessment opportunities for *Unit 1: Information Technology Systems* and, *Unit 2: Creating Systems to Manage Information* and *Unit 11: Cyber Security and Incident Management* are offered in both the January and June series.

Unit 1 is mandatory and it is suggested that it is delivered from the start of the course using a staggered approach across the full programme duration so that this can be delivered

alongside other units. Learners following a two-year course would have multiple opportunities for entry in January and June and, if necessary, multiple resit opportunities. The 'long and thin' approach would also give centres the opportunity to build in examination preparation time, once internally assessed units have been completed.

Delivered over 2 years, Units 2 and 11 would also benefit from a more staggered, drawn-out approach but, if being studied over one year, it would be necessary to use a 'short and fat' approach, with delivery in the Autumn term and assessment in the January series, allowing learners a resit opportunity, if necessary, in the June series.

Given the synoptic Nature of Unit 14, this would benefit from a long and thin approach to ensure learners have covered enough of the content to satisfy the assessment of the unit. If being studied over one year, it would be necessary to use a 'short and fat' approach, with delivery in the Autumn term and assessment in the January series, allowing learners a resit opportunity, if necessary, in the June series.

### Internal units

It would probably be best to deliver *Unit 3: Using Social Media in Business* in the Autumn/Spring terms. This would help ensure that the assignments are available for standards verification in a timely manner. It would also mean that learners would benefit from a more focused experience that will build skills quickly.

Units 4 and 9 could also be delivered 'short and fat' to ensure all criteria are covered ready for the assessment of the synoptic unit. A long and thin approach can also be taken for two-year delivery as long as adequate planning has taken place to ensure learners have developed the knowledge requirements for the external synoptic assessments.

### Optional units

Learners must choose six optional units from a list of 14 available units (full list available at http://qualifications.pearson.com/content/dam/pdf/BTEC-Nationals/Information-Technology/2016/specification-and-sample-assessments/9781446939512-BTEC-nat-L3-extdip-IT-spec-prepub.pdf).

It would probably be best to deliver these optional units in the Autumn/Spring term if learners are following a one-year course. This would help ensure that the assignments are available for standards verification in a timely manner. However, learners on a two-year course may benefit from delivery of these units in the Summer term. Again, it would also mean that learners would benefit from a more focused experience that will build skills quickly.

### Assessment

There are three types of assessment in the BTEC Level 3 National IT qualifications:

### External

- **Written examination** – this examination is set and marked externally. Centres will need to ensure that learners are entered for these examinations as there are potentially up to two windows per year and Pearson is unable to predict when your learners will be ready. That said, there are distinct benefits to undertaking the external assessments later in the course once learners have had an opportunity to use their theoretical learning in the practical work in internally assessed units.
- **Set task** – this task is set and marked externally. Centres will need to ensure that learners are entered in line with windows of opportunity. The latest time tables should always be referred to: http://qualifications.pearson.com/en/support/support-topics/exams/exam-timetables.html

**Internal**

- Assignment – the assignment is set and marked internally. This assessment method is familiar to all BTEC tutors and continues to be the focus of activity with the opportunity to link assessments to employers and working practices as has always been the case.

**Synoptic**

Although synopticity has essentially been at the core of BTEC delivery and assessment since its creation, there is now a more formal approach to evidencing synopticity with units designed to enable synoptic assessment to take place through a variety of assessment methods.

In delivering the synoptic units, you should ensure that learners are able to apply knowledge and understanding from a variety of units to their completion of the assessment.

# Making the right choice for your learners

The suite of qualifications is intended to be inclusive and support individuals in their progression. The prior achievement and aspirations of learners is key to advising the most appropriate study programme. This would ideally combine in-depth discussion with a portfolio and qualification review.

For learners who wish to progress directly to higher education, there are a range of qualifications in the suite that ensure that they will have the skills to cope with the academic and independent learning.

# Making contact with employers

Employer contact is one of the most cherished experiences BTEC National learners can have, by ensuring realistic and valuable learning.

While you may have your own contacts at centre level, you may be able to source additional employers through the wide variety of IT and Computing trade association membership bodies.

Any organisation identified with a * has an open list of members included on their website.

| | |
|---|---|
| **UKITA*** | http://www.ukita.co.uk/ |
| **ITSMF** | http://www.itsmf.co.uk/ |
| **TechUK*** | https://www.techuk.org/ |
| **Manchester Digital*** | https://www.manchesterdigital.com/ |
| **Digital Birmingham** | http://digitalbirmingham.co.uk/ |
| **Digital Union*** | http://digiunion.co.uk |
| **British Computer Society** | www.bcs.org |
| **CREST*** | http://crest-approved.org/ |
| **The Tech – Partnership*** | https://www.thetechpartnership.com/ <br> For a list of employers who have signed up to the Partnership see here: <br> https://www.thetechpartnership.com/about/the- partnership/employers/ |
| **Institution of Analysts and Programmers** | http://www.iap.org.uk/main/ |
| **Women in Technology** | http://www.womenintechnology.co.uk/ |
| **UKWDA (UK Web Design Association)** | http://www.ukwda.org/ <br> For a list of employers who are premium members see here: http://www.ukwda.org/premium-members |

| Institution of Analysts and Programmers | http://www.iap.org.uk/main/ |
|---|---|
| The Institute of Engineering and Technology | http://www.theiet.org/ |
| National Computing Centre | http://www.ncc.co.uk/ |

In addition, there are a number of large employers who also have an education function. These provide a range of services including ideas on improving the effectiveness of learning, case studies. These include the following.

| **Barclays** – Barclays Code playground, introducing Digital Eagles (coding experts working with young people) | http://www.barclays.co.uk/DigitalEagles/Barclays CodePlayground/P1242686640999 |
|---|---|
| **Microsoft** – Edupreneurship collaboration | https://education.microsoft.com/ |
| **Oracle** – Introducing the Oracle Education Foundation | https://www.oraclefoundation.org/ |
| **IBM** | http://www-935.ibm.com/industries/education/ |
| **Cisco** – The Cisco Networking Academy | https://www.netacad.com/ |
| **Coca Cola** – The Real Experience – Real Business Challenge and Real Education Centres | http://www.therealexperience.co.uk/ |
| **Toshiba** – Ambassadors Programme | http://www.toshiba.co.uk/generic/education-workshops/ |

There are currently 39 LEPs (Local Enterprise Partnerships) in the UK. These voluntary partnerships between employers and local authorities were set up in 2011 by the Government's Department for Business, Innovation and Skills (usually called BIS) to identify local opportunities for economic growth and jobs. Find your local LEP through the following link: http://www.lepnetwork.net/about- leps/

Many of the IT vendors also have education services including the following – this is in addition to organisations such as Microsoft, Oracle and Cisco listed above:

| | |
|---|---|
| **CompTIA** | https://www.comptia.org/ |
| **Axelos** | https://www.axelos.com/ |
| **LPI (Linux Professional Institute)** | https://www.lpi.org/ |
| **VMWare** | http://www.vmware.com/uk |
| **Voluntary clubs and other organisations:** | |
| **Code Club** | https://www.codeclub.org.uk/ |
| **Technokids** | http://www.technokids.co.uk/ |
| **TechFutureGirls** | https://www.techfuturegirls.com/ |
| **BetaPlus** | http://betaplus.org.uk/index.php |
| **Teentech** | www.teentech.com |
| **CoderDojo** | https://coderdojo.com/ |
| **The Pixel Gang** | http://www.thepixelgang.co.uk/ |

You should also consider making links with local universities who will also have links to employers.

## Employability skills

Employers not only look for technical skills, but also employability skills. These include:

- **Self-management:** readiness to accept responsibility, flexibility, time management, readiness to improve own performance
- **Teamworking:** respecting others, cooperating, negotiating/persuading, contributing to discussions
- **IT and customer awareness:** basic understanding of the key drivers for success in the sector and the need to provide customer satisfaction
- **Problem solving:** analysing facts and circumstances and applying creative thinking to develop appropriate solutions
- **Communication and literacy:** application of literacy, ability to produce clear, structured written work, and oral literacy (including listening and questioning)
- **Application of numeracy:** manipulation of numbers, general mathematical awareness and its application in practical contexts
- **Application of information technology:** basic IT skills including familiarity with word-processing, spreadsheets, file management and use of internet search engines.
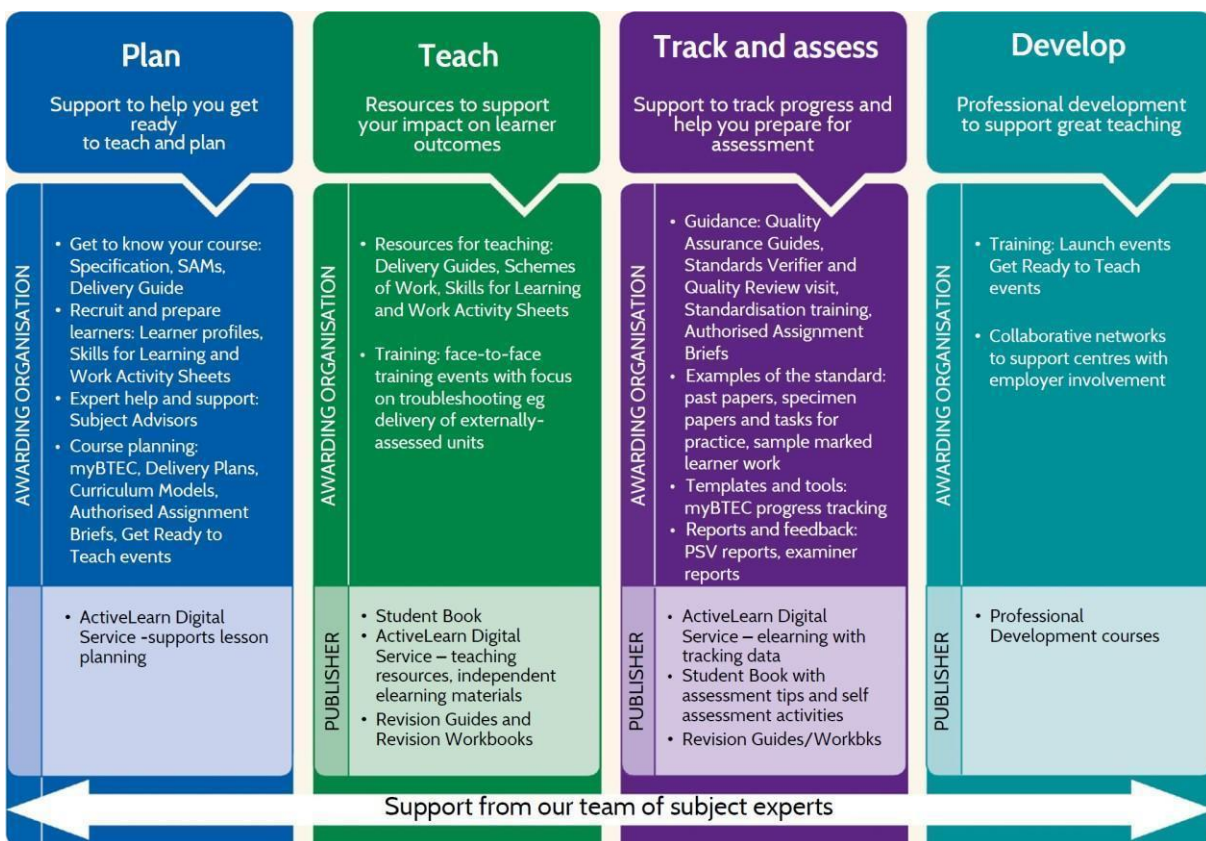
# SUPPORT AND RESOURCES

There are a wealth of resources available to ensure you feel confident delivering your BTEC National qualification throughout your entire course.

All the 'Awarding Organisation' resources can be found on the Pearson Qualifications website here: http://qualifications.pearson.com/en/qualifications/btec-nationals/enterprise-2016.html#tab-4

As well as the free resources supporting the qualification, provided by Pearson as an Awarding Organisation, Pearson Learning Services ('Publisher' in the tables below) provides a range of engaging resources to support BTEC Level 3 Nationals. The diagram below lists the resources available (by format and best usage category).

| **Plan**<br>Support to help you get ready to teach and plan | **Teach**<br>Resources to support your impact on learner outcomes | **Track and assess**<br>Support to track progress and help you prepare for assessment | **Develop**<br>Professional development to support great teaching |
|---|---|---|---|
| **AWARDING ORGANISATION**<br>• Get to know your course: Specification, SAMs, Delivery Guide<br>• Recruit and prepare learners: Learner profiles, Skills for Learning and Work Activity Sheets<br>• Expert help and support: Subject Advisors<br>• Course planning: myBTEC, Delivery Plans, Curriculum Models, Authorised Assignment Briefs, Get Ready to Teach events | **AWARDING ORGANISATION**<br>• Resources for teaching: Delivery Guides, Schemes of Work, Skills for Learning and Work Activity Sheets<br>• Training: face-to-face training events with focus on troubleshooting eg delivery of externally-assessed units | **AWARDING ORGANISATION**<br>• Guidance: Quality Assurance Guides, Standards Verifier and Quality Review visit, Standardisation training, Authorised Assignment Briefs<br>• Examples of the standard: past papers, specimen papers and tasks for practice, sample marked learner work<br>• Templates and tools: myBTEC progress tracking<br>• Reports and feedback: PSV reports, examiner reports | **AWARDING ORGANISATION**<br>• Training: Launch events Get Ready to Teach events<br>• Collaborative networks to support centres with employer involvement |
| **PUBLISHER**<br>• ActiveLearn Digital Service -supports lesson planning | **PUBLISHER**<br>• Student Book<br>• ActiveLearn Digital Service – teaching resources, independent elearning materials<br>• Revision Guides and Revision Workbooks | **PUBLISHER**<br>• ActiveLearn Digital Service – elearning with tracking data<br>• Student Book with assessment tips and self assessment activities<br>• Revision Guides/Workbks | **PUBLISHER**<br>• Professional Development courses |

Support from our team of subject experts

In addition to the 'publisher' resources listed above, publishers other than Pearson may produce textbooks that are endorsed for BTEC. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

There are also a number of people who are available for you to speak to:

- **Standards Verifiers** – they are subject specialists who can support you with ensuring that your assessment plan is fit for purpose and whose role is to confirm that you are assessing your learners to national standards as outlined in the specification by providing quality assurance through sampling.
- **Curriculum Development Managers (CDMs)** – they are regionally based and have a full overview of the BTEC qualifications and of the support and resources that Pearson provides. CDMs often run network events.
- **Customer Services** – the 'Support for You' section of our website gives the different ways in which you can contact us for general queries. For specific queries, our service operators can direct you to the relevant person or department.

| **ICT Subject Adviser** |
|:---:|
| **Tim Brady** |
| UK: 020 7010 2161 |
| Intl: +44 (0)20 7010 2161 |
| TeachingICT@pearson.com |
| TeachingComputerScience@pearson.com |

Training for the new BTEC Level 3 Nationals can be found on the Pearson website: http://qualifications.pearson.com/en/support/training-from-pearson-uk.htm

**September 2017**

**For information about Edexcel, BTEC or LCCI qualifications visit qualifications.pearson.com**

**BTEC is a registered trademark of Pearson Education Limited**

# UNIT 1: INFORMATION TECHNOLOGY SYSTEMS

## Delivery guidance

### Approaching the unit

In this externally assessed unit, you can help your learners to explore how computer hardware, digital devices, and relevant software combine to form small- and large-scale systems. You should focus on developing learners' understanding of how Information Technology systems (IT systems) can be used in vocational contexts to solve problems and/or meet the needs of organisations and users. Learners will need to be able to analyse the impact of IT systems, evaluate the effectiveness of systems in a range of contexts and, where appropriate, suggest and plan improvements to current solutions. Learners should be able to make justified recommendations for the solutions they propose.

There are many ways in which IT systems are used to solve problems. You should expose your learners to a wide range of effective, and less effective, uses of IT systems. In addition to the obvious business systems, there are many examples in the real world that can be used to illustrate the power of IT such as 'fly-by-wire' air travel, 'just-in-time' manufacturing, computerised banking and the use of IT in health (such as in hospitals as part of diagnostics, automated treatment and patient monitoring). In each case, these are examples of different technologies that are used together in different ways to solve a range of problems and improve the way people work. Prepare learners to use IT systems effectively and be able to think about the wider implications of their application and use, by giving them opportunities to develop analytical and decision-making skills, that would be of benefit in a managerial or project management role. For example, they should be able to analyse problems related to IT systems and make reasoned suggestions as to how IT systems can be used in a range of settings in comparison to alternatives (where appropriate). The key with IT is to find the best solution to solve a problem, but this does not mean that there is always a 'right' answer.

In the Extended Certificate, this unit is designed to be synoptic in nature and draws on core knowledge from a range of other units within the qualification. While the unit can be delivered as a single unit, learners are likely to perform better when sitting the unit towards the end of the course when they have experienced a range of internally assessed units.

This delivery guide does not cover everything that needs to be delivered to complete this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered. In the external assessment, learners may be tested on any of the content in the specification.

### Delivering the topics

For topic A, show your learners how digital devices can be used individually or in combination with other devices to form small- and large-scale IT systems. You

should be aiming to develop your learners' understanding of how the features of different digital devices affect their use in an IT system, as well as the implications of the relationship(s) between devices and relevant peripherals. Make learners aware of the important role that software plays in any system and show them how to analyse the way in which the features and uses of different types of software have an impact on the effectiveness of an IT system overall. Equip learners with up-to-date knowledge of IT systems and give them opportunities to explore emerging technologies and the associated implications for organisations, IT systems and users.

You should also give learners opportunities to explore a range of contexts to which they can apply their knowledge and demonstrate their ability to choose appropriate IT systems to meet a range of needs. You should help them to use their knowledge to make decisions, plan, and evaluate IT systems. Topic B asks learners to explore the ways in which data is transmitted within and by computer systems. Allow learners to explore the technologies that enable devices and systems to communicate and share data with each other, and how the features and characteristics of these technologies affect the system and its effectiveness. You should make learners aware of different connection types, the role of different networks and the issues relating to the use of technologies for transmitting data.

Learners should understand that there is often a range of possible solutions and success in IT is being able to explore and evaluate these to find the best fit. They should understand that there will be occasions where the solution chosen may be a compromise due to the limitations on available technologies, cost or efficiency, compatibility between new and existing systems, and perceived benefits such as improved productivity or security. For topic C, learners should explore how the increased use of internet-based technologies and services affect the way users and organisations use and interact with IT systems. You should allow learners access to different online systems for accessing, sharing and storing data. Ask them to research the way in which using online communities is integrated into many aspects of the IT systems used by individuals and organisations. Help learners to develop a strong understanding of the capabilities and limitations of available services, technologies and procedures, as well as to explore how and why these technologies are used.

Learners should not forget that there could be negatives coming from operating online as well as positives and there will be significant opportunity for discussion on issues such as personal privacy.

In topic D, introduce learners to the threats to IT systems, and the data they store and use. Ensure that learners are able to assess the impact that a threat may have on a given situation if adequate steps are not taken to mitigate it. Ask learners to explore ways in which IT systems can be protected from threats and the implications associated with implementing (or not) the identified protection. Learners should be able to consider threats to small- and large-scale systems as well as the measures and responsibilities, at personal and organisational level, that can protect systems. Introduce learners to the relevant UK and European legislation that governs the use and protection of IT systems and the data they contain.

For topic E, learners should consider how small- and large-scale organisations make use of IT systems and the impact these have on how they fulfil their aims. Ask learners to explore how common, and cutting edge, IT systems are implemented in a range of vocational areas (as listed in topic E1). You should encourage learners to make links between this and earlier topics in order to develop a clearer understanding of how organisational needs are met. For example, when exploring IT systems in retail, a scenario could be used in which

learners first explore the components of a particular system (hardware, software, data transmission etc), and look at how each of the components fills a specific (or set of) function(s). They could then consider how these meet the needs of the organisation. It would be beneficial to compare these with other scenarios to consider how/why they differ.

Make learners aware of the importance of data in personal and professional/organisational systems. Explain to your learners the ways in which data is collected, interrogated and used by a wide range of IT systems. You should give learners opportunities to explore ways in which data is collected and how its accuracy is ensured. Learners should explore how the source and collection of data can have an impact on its usability and the implications for individuals and organisations of using IT systems to collect, store and process data.

For topic F, learners should explore the moral, legal and ethical issues resulting from the use of IT systems. You should demonstrate to learners how the use of IT systems by individuals and organisations affects how people conduct their personal and professional lives, and the subsequent implications. Help your learners to gain a strong grasp of relevant UK legislation relating to the use of IT systems, as well as guidelines and codes of practice produced by relevant professional and public bodies. It is essential that learners know how to remain informed about legal issues, for example the sources of information. Where can they access information that ensures that they remain up to date?

Throughout this unit, give learners a range of opportunities to explore and analyse situations to identify problems, suggest and evaluate solutions, and discuss wider considerations of implementing and using IT systems. The content for all topics should be delivered by means of a combination of tutor presentations, individual and group learning tasks, visits, guest speakers and detailed case studies.

In preparation for assessment, centres should ensure that learners understand what is meant by the command words used, (as detailed in the units) and that during teaching learners undertake classwork to demonstrate understanding of what is required to obtain full marks in response to these command words. For example: how to obtain the full six marks for a question where the command word is 'explain', or a ten mark question where the command word is 'analyse'. Tutors can effectively utilize standard writing rubrics to support this learning such as BLT, (because, leading to, therefore) and PEEL, (point, evidence, explanation, link), for medium and extended answer questions. Centres should make full use of the sample assessment materials (SAMs) and Mark Schemes that are on the Pearson website.

## Assessment guidance

Learners will be assessed by means of a written examination paper, which will include short-answer questions, extended tasks and tasks requiring diagrammatical explanations and solutions. This will assess technical and theoretical understanding as well as their problem-solving skills. For full details of assessment, refer to the SAMs and the specification.

In preparation for the examination, learners should respond to vocational scenarios to explore using IT systems to meet specified needs and solve problems. Learners should be able to discuss, analyse, evaluate and design small- and large-scale IT systems. Applying these skills should be supported by the development of exam techniques, such as how to identify the requirements of specific command words and how to structure and present answers.

This unit is synoptic in the Extended Certificate. In this qualification you should ensure that learners have undertaken a variety of units and are prepared to apply knowledge and understanding from across these units in the completion of their assessment.

# Getting started

**This gives you a starting place for one way of delivering the unit.
Activities are suggested in preparation for the external assessment.**

## Unit 1: Information Technology Systems

### Introduction

IT systems support and enable individuals and organisations to achieve their aims and are present in almost everything people do. Being able to effectively select and use appropriate IT systems is a valuable skill in any area, vocational or personal. In delivering this unit, you should give learners a sound knowledge of a wide range of IT systems that are used to support the aims of individuals, groups or organisations. Learners should be able to apply this knowledge to identify needs and plan solutions as well as analyse and evaluate situations and outcomes relating to using IT systems. These transferable skills will equip learners for further study or employment in a wide range of vocational areas.

### Topic A – Digital devices in IT systems

- You could begin by introducing the aim of the unit (ie to become a highly skilled IT user who can analyse situations in order to select appropriate IT systems), and how an understanding of IT systems, including their possibilities and limitations, can be applied to plan solutions and analyse and evaluate outcomes or decisions in many situations.

- Introduce learners to the concept that an IT system can be anything from a single digital device to a global collection of computers and interconnected devices. Explain that even large IT systems are often made up of smaller devices across a range of technologies that can perform both an isolated individual role or be part of a larger IT system.

- It might benefit you to establish a baseline understanding of learner concepts of digital devices. You should start with common devices such as computers and mobile devices before moving to more specialised or less common devices. You may wish to introduce digital devices along with an overview of the tasks that they can perform to give the learners a little context. At the very early stages, this should be just in enough depth to understand the concepts – learners will develop deeper and more complex understanding of 'how' and 'why' as the unit progresses.

- You should ensure that learners understand the concept of 'input – process – output' and that this is the basis of any computer system. Establish the level of learners' understanding of common hardware used by computer systems. You may wish to spend some time ensuring that learners have a sound grasp of subject specific terminology in this area.

- Through a range of group and individual activities, you should give learners opportunities to explore the concept and implications of software in IT systems (topic A3). You should introduce learners to more common uses of software first before progressing to more specialised software. For example, in the modern world there are very few organisations that do not use computers and a range of software to manage their activities.

  However most organisations recognise that technology in the wider context can improve their core activity and organisational efficiency – use examples from:

  o education (such as remote learning, interactive learning, the use of MOOCs)

  o health and social care (faster critical response with higher quality information,

improvements in post-operative care through the interconnectivity of support services)

- o manufacturing (research and development and the use of IT in design, prototyping through the use of 3D technologies such as 3D printing, and CAD/CAM systems for managing the full manufacturing processes).

- Make learners aware of both established and emerging technologies and how they influence the ways that individuals and organisations use IT systems. How does the Internet of Things (IoT) revolutionise manufacturing? How does Big Data measured in real time contribute to maintenance in manufacturing to improve downtime and reduce costs? You could give further local opportunities for this, and traditional classroom based activities can be supported by visits and guest speakers.

- Give learners practical tasks where they will analyse scenarios and make informed choices regarding selecting IT systems. Learning activities should be supported by realistic scenarios that allow learners to consider a range of factors that influence the choice of parts, or all, of a system. For example – a large company wishes to introduce a CRM (Customer Relationship Management) system that will be used across the business by both technical and non-technical users including office based and field based staff. How would all users interact with the systems – what technologies could be used? What would the concerns be? Are there any technical restrictions that would need to be accommodated? This is a potential scenario that could be used for a whole class discussion with all learners allowed to contribute. Learners should remember that there is no right answer but, as IT practitioners, they must be able to defend their judgement. There are natural links between this and other topics in this unit and, after ensuring that learners have established a strong grounding in the concepts of systems and hardware and software, you should continue to develop and reinforce their understanding of this topic area in conjunction with other topics.

## Topic B – Transmitting data

- It may be helpful to introduce this topic to learners by asking them to consider different methods of connecting devices and systems and think about some of the features, limitations and implications of different connection methods.

- Where possible, give learners practical tasks and opportunities to select and use different connection methods to achieve different aims. Allowing learners to compare results from first-hand experience will give them a clearer idea of what can or cannot be achieved.

- Demonstrate to learners how devices and systems can be connected to form different types of network. Learners should develop a strong grasp of how different types of network are used and the factors that influence the choice of network. Make your learners aware of how the component parts affect the function and performance of the network as a whole. The learning for this topic area can be supported by a range of activities including:

- o visits to local employers to see how networks are used to meet organisational, user and customer needs

- o individual and group research and discussion tasks supported by guest speakers and case studies of real-world examples such as the local library that has to interconnect with regional and national systems for inter-library loans, or transport systems (such as busses) which have GPS updates that are transmitted to bus stops further down the line to keep customers up to date about the arrival of the next bus etc

- o practical activities involving setting up and using different types of network.

- Explain to learners that, as well as the impact of the devices and other hardware

that form the network, there are other factors that need to be considered when transmitting data. Give learners opportunities to explore these other factors, which include the protocols used, security issues and bandwidth. They should understand, for example the implications of compression used to reduce file sizes and speed up transmission

● Ask learners to work through tasks based on a variety of scenarios and to plan solutions and/or make and evaluate decisions relating to transmitting data. Learners should be able to consider a wide range of implications and apply them to realistic and varied examples. Where possible, these tasks should include a scenario that contextualises the learning. Vary the level of scaffolding made available for the devised tasks. Examples could include the photographer sending image files to a printing service, a group of architects in different locations sharing a series of architectural drawings or a graphic designer working on illustrations for a new book.

## Topic C – Operating online

● Due to the integrated nature of many modern systems, depending on the scenarios used, there will be areas of this topic that you may have already touched upon during previous topics. It would be beneficial to draw learners' attention to these natural links using suitable visits and case studies.

● Explain to learners the ways in which online systems are used by individuals and organisations. Learners should explore the features of a range of different online systems that are used to store data and perform tasks (such as contributing to an organisation's disaster recovery plan), and investigate the impact and implications of these systems.

● Give learners opportunities to explore the widespread integration of online communities with personal and professional activities, for example learners could investigate Microsoft's purchase of LinkedIn. What was the rationale for this purchase and what benefits were there to Microsoft? Were there any drawbacks? They should understand the features and services that these communities offer individuals and organisations, and the impact and associated implications of their use. Will all LinkedIn customers be happy about their data being available to a large commercial company?

● You should enable learners to develop the ability to analyse impacts and implications beyond superficial levels. Ask them to explore a wide range of factors (as listed in the relevant specification points) and consider how these factors link with, and have an impact on, each other.

## Topic D – Protecting data and information

● You should give learners opportunities to explore the potential threats (accidental and malicious) to data and information stored on and used by IT systems. The subject content could be introduced by tutor presentations and individual and group research tasks. Learners' understanding of the characteristics, impact and implications of these threats could be developed using case studies and real-world examples. Examples could include the Northern Ireland Prison Service data breach (May 2016), the Thames Valley Police Officer who was sentenced for breaching data security (June 2016), personal data lost by 132 councils (November 2011) – BBC News site, or the article from the Daily Mail Online which claims that 2000 NHS patient records are lost every day.

● Ask learners to consider ways in which systems can be protected from potential threats. You should ask them to explore the ways in which individuals and organisations can reduce potential risk and mitigate damage to, and loss of, data. Learners should be made aware of the responsibilities of individuals (in personal and professional settings) and of organisations to ensure that data is safe and the relevant codes of practice and legislation that support and enforce this are in place.

The financial services industry contains many possible case studies.

- You should help learners develop the ability to analyse the impact and implications of these risks beyond superficial levels. Through real-world examples, case studies and discussion, you should allow learners to explore how relevant factors are linked and how considering one thing may have an impact on another. For example, a decision to employ new software or access procedures to manage security could have an impact on employee productivity. Employees may need to be trained, there may be more processes they have to go through to share data, or it may simply take them much longer to start work in the mornings because of additional security steps they need to take. Due to the integrated nature of many modern systems, depending on the scenarios used, there will be areas of this topic that may have already been touched upon during previous lessons.

## Topic E – Impact of IT systems

- You should give learners opportunities to explore how online services are used to meet the needs of organisations and individuals in a range of contexts (as listed in topic E1), through a combination of research, case studies, visits and guest speakers. What has happened to the high streets of many large towns with businesses opting to sell online (with reduced costs, staffing, premises etc)? Is this good news for consumers? How does it impact on the local economy?

- When exploring topics E1 and E2, ask learners to draw on their knowledge of previous topics studied in terms of how systems are formed, how they communicate etc. However, learners should have the opportunity to expand this knowledge. For example, when exploring the purpose and features of online and IT systems, you could introduce specialised devices and software or the concept of using common or familiar IT systems to perform specialised tasks.

- Make learners aware of the importance of data, and how it is collected, stored and processed by IT systems. Ask learners to explore the implications of storing, using and processing data for individuals and organisations. Explain how data can be collected and processed, and ways in which the accuracy and reliability of data can be improved. Learners should be able to apply their understanding to real-world scenarios. The learning can be supported by a number of activities such as:

  o research projects exploring and comparing the usefulness, reliability and accuracy of primary and secondary sources

  o data collection exercises which use different collection methods or involve creating data collection systems for others to use, for example using wearable technologies to gather data used in sports performance analysis

  o creating and using numerical models in spreadsheet software, for example using what..if modelling to process a number of scenarios with changing variables (what the impact will be of increased oil prices on profitability in a logistics business)

  o creating and using database software

  o individual and group research and discussion tasks supported by guest speakers (particularly from a market research or marketing company) and case studies of real-world examples.

## Topic F – Issues

- This topic covers the legal, moral and ethical issues resulting from the use of IT systems. You should give learners opportunities to explore a range of scenarios covering using IT systems in professional and personal contexts, from which they should consider the implications for individuals, organisations and wider society. For example, the ethical dilemma around job displacement, the ownership of

> intellectual property and non-disclosure with regards to an organisation's information and activity, and the control organisations can exercise to monitor employees during working hours through their online activity.
>
> - Ask learners to draw upon their understanding of earlier topics studied in order to promote the development of their knowledge throughout this topic. For example, when considering online services such as social media, the issues such as privacy, freedom of speech and so on, are natural considerations to explore. Learners should be aware that many of the topics in this unit have natural and logical links to others. Exploring these links should be encouraged and this would typify the requirements for higher attainment in this unit.
>
> - Give learners tasks that require them to explore the features and concepts of relevant legislation and codes of practice. They should understand how individuals and organisations implement these and the subsequent implications of following, or not following, the specified rules and guidelines. What are the ramifications of not adhering to codes of practice? Do learners remember what they signed up to at their own centre in terms of what constitutes acceptable use of IT systems? You could walk learners through any centre-related document and ask them to discuss the relevance and appropriateness of the content.

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

Pearson BTEC Level 3 Nationals in IT (NQF):

- *Unit 2: Creating Systems to Manage Information*
- *Unit 3: Using Social Media in Business*
- *Unit 4: Programming*

## Resources

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

### Journals

- www.mdpi.com/journal/computers
  A free, open access journal that publishes peer-reviewed academic papers for all computing sectors.

### Websites

- www.legislation.gov.uk
  UK government website containing information about UK legislation and subsequent updates and amendments.

- www.bbc.co.uk/news/technology
  British Broadcasting Corporation – this site has news and information regarding technology and IT.

- www.forbes.com/technology
  Forbes.com LLC™ – this site contains news and information regarding technology and IT.

- www.gchq.gov.uk/Pages/homepage.aspx
  This is a government website dedicated to data security.

# UNIT 2: CREATING SYSTEMS TO MANAGE INFORMATION

## Delivery guidance

### Approaching the unit

This unit introduces the concept of database systems and how they store, manipulate and present data. Your learners will need to investigate how databases are used, and how they are designed, developed and maintained. In addition, learners should investigate relational database management systems (how they are used and how they are developed), before producing their own relational database in accordance with a brief. Learners should appreciate that databases are very widely used in a huge range of applications with which people interact on a daily basis (including e-commerce, customer billing, stock management, manufacturing processes, logistics, healthcare, banking and the creative industries).

You will need to ensure that learners have access to an adequate relational database management system in order to complete the assessments for this unit.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered. Learners must practise the correct and full completion of any templates in the SAMs or past papers in preparation for their external assessment task.

### Delivering the topics

For topic A, you could begin by discussing the types of data that might be stored by different individuals and organisations. Learners should explore why they might need this data and how it could be organised. You should explain relational database management systems (RDBMSs) and which environments they are suited to.

Help your learners to become familiar with relational data structures. To do this, give them plenty of vocational examples in order to build their confidence with the components of relational data structures.

Learners must understand the process and stages of normalisation. You should make practical examples of normalisation and demonstrations of data in various normal forms available. The best learning will be achieved where learners are given sample documents that they then have to normalise – for example an invoice, with an example of a customer record, a stock record and a pricelist. These four items would be used by any business with a retail function. An alternative could be a learner personal record, class register, course information and assessment grades. Help learners to become confident with the process of normalisation and creating data structures, as this will be a key part of the assessment. It is important that learners fully understand how to do this as otherwise the rest of the design and development process may be difficult or impossible.

In topics B and C, learners will need to design and develop their own database using a selected RDBMS. Learners must understand what options are available and it is recommended that you introduce them to an RDBMS early in the unit to allow plenty of time for them to practise their skills and combine theory with practice.

For topic B, learners should be aware that, as with any software design, they need to be familiar with exactly what is required and the scope of the solution (what is included and what is not included). You should guide learners in the process of choosing appropriate methods to use in their designs. Introduce the techniques used in database design to help learners become confident in applying those that they will use in their own designs. As well as designing the structure of the database, learners need to be able to design a functioning user interface for their database.

You should place emphasis on the laws, legislation and ethical considerations that impact on the storage of data, especially if the data may be sensitive (eg medical records).

Topic C is about implementing the design and is therefore mostly a practical topic. Help learners to prepare for the assessment by developing their skills so that they can use the database software to create a solution quickly and without assistance. Build in plenty of practice time using a range of different case studies to ensure that their skills reach the required level.

In topic D, learners will evaluate the process of designing and developing a database. It may be wise to integrate some aspects of this topic with the earlier topics to prepare learners for larger projects. You could ask them to keep a diary of their experiences so that they have plenty of material on which to base their evaluations. Group or paired activities in which learners review and evaluate each other's work can also be useful, as learners tend to be more critical of other peoples' work than their own.

## Assessment guidance

Learners will be assessed by a series of practical tasks that will assess both their ability to design a suitable database to meet a client's specification and their practical skills in using database software to implement their design. The assessment will include a series of six activities that can be completed using the software of the centre's choice. Centres should advise learners to pay careful attention to the assessment focus for each activity in the SAMs as these give the learning criteria for the assessments.

In preparation for the examination, learners should design solutions to given problems using normalisation, entity relationship diagrams (ERDs) and data dictionaries. They will need to develop their solutions by creating a database structure, importing raw data, and creating forms, queries and reports. The practical application of these skills should be supported by developing exam techniques, such as how to identify the requirements of specific command words and how to structure and present answers.

# Getting started

**This gives you a starting place for one way of delivering the unit.
Activities are suggested in preparation for the external assessment.**

## Unit 2: Creating Systems to Manage Information

### Introduction

As this unit is externally assessed, it is important that you work to develop learners' practical database design and development skills to the level where they can complete the process confidently, under pressure and without assistance. You will need to plan for both practical and exam-technique practice sessions as part of your delivery.

### Topic A – The purpose and structure of relational database management systems

In topic A learners will investigate databases and RDBMSs.

- Learners will need to understand the purpose of a database; how they organise data and how it is inserted and retrieved. Learners will probably have lots of experience in using databases but might not realise that a database lies behind things like internet search engines, e-commerce sites, banking etc. Ask them to think about the way in which the data behind these systems is organised/structured as this will lead into the topic of normalisation.

- Normalisation is a key subject within this topic and one that is conceptually quite hard to grasp. You should give learners demonstrations and examples of how to normalise various examples of data and relate this to real-life scenarios. Beginning with a single document, then adding documents to increase the complexity will help learners build their understanding. It would be beneficial for learners to have sample data to review as you discuss normalisation so that they can discuss the implications on the data stored. They should practise doing this in a range of contexts. For example, a boarding kennel accommodating individual and families of dogs or cats. All animals need to have been inoculated before the start of a stay at the kennels. This will essentially mean a booking system, with customer data and animal data.

- Even at this early stage in the unit, it is probably wise to introduce learners to an RDBMS and structured query language (SQL) and allow time for learners to work with these development tools regularly. This will not only allow them to see how the theory relates to the practical application but will also give sufficient time for them to develop the required degree of skill and confidence in using these tools before the assessment.

### Topic B – Standard methods and techniques to design relational database solutions

If learners are also completing *Unit 4: Programming*, there is some overlap with this topic and learning aim B (Design a software solution to meet client requirements) in *Unit 4*, so you may want to consider delivering some subjects covered in these units together.

- Learners will need to be familiar with techniques used in database design and be confident in applying those that they will use in their own designs.

There will, of course, be a close link with the normalisation theory taught in topic A and you may want to teach creating ERDs immediately after teaching normalisation.

- Put learners into groups and ask them to review earlier concepts such as normalisation and the creation of ERDs and consider how these might apply to the database that they would like to design. Whether learners work individually or in groups, they will gain useful insight from group discussions and comparing each other's designs.

- Learners must be familiar with software development principles and the design documentation that is expected of them. Refer to the SAMs to see the format of the design documentation that learners will be expected to produce in the exam and ensure that they use similar documentation while practising the skills.

- Set up workshop sessions in which learners are able to review their designs with their peers and refine their designs as necessary. Learners could present the concepts of their database designs to the class and invite their colleagues to comment and suggest improvements. Learners should make a note of any refinements required.

- Learners can work in groups to develop and review user interface designs and security considerations.

- While working on understanding database design concepts, learners will also need to continue to develop their skills in using database software, as designs will be easier to create if learners have a good understanding of what the software is capable of doing.

## Topic C – Creating a relation database structure

In this topic, learners will develop their skills in using database software to create a system from a design that they have produced. They should already have made some use of the database software to put the theory covered in topics A and B into practice, but this is where they will really need to hone their skills to become confident and proficient at applying them.

- The key to success here is practice, practice, practice. Some time spent creating imaginative and different case studies will be beneficial. It may also be useful to get the learners to work on different scenarios rather than all use the same ones, as this will create better opportunities for learners to review and give feedback on each other's work. Scenarios could include a music shop that sells new and used musical instruments, which runs a lending service and that does instrument repairs or a peripatetic languages teacher who provides services to all local secondary schools.

- Encourage your learners to write copious notes on the techniques they practise and their experiences of using them. These notes will help when they are preparing for the exam and also when they need to evaluate their databases in topic D.

- Testing is often an area that learners neglect. Encourage learners not just to think of testing in terms of whether something works or not, but also in terms of whether something can be improved. The user interface is an obvious candidate here. Ask learners the following questions.
  - Is it clear and intuitive?

- o Will the intended users of the database be able to understand it?
- o Queries and reports are also candidates for suitability testing. Are the reports clear?
- o Does a query produce an appropriate output and are suitable fields included?

It may be effective to do at least some of the testing in pairs, with learners testing and reviewing each other's databases.

- Learners could develop their skills in, and understanding of, testing by being given databases in varying degrees of completion and with different features. They could be given a variety of activities including developing and implementing a test plan to use with the databases and responding to the provided test results for a given database. They could also test different aspects of the databases such as data input/validation and the user interface.

## Topic D – Evaluating a database development project

In this topic, learners will need to further develop their reviewing and evaluating skills.

- Ideally, learners will be able to evaluate some of the databases that they have created as practice in topic C. However, it may benefit them to look at some commonly used databases such as product-search databases on e-commerce websites. Learners could consider how well these databases meet their needs (eg how easy is it to find the product they are after? Does the search allow them to select suitable criteria? Is data presented in a helpful order? Is the interface intuitive?). This may help them to review their own databases and develop better user interfaces.

- Encourage learners to think more deeply about the process and outcome rather than simply considering whether they have produced a good database or not. They need to look at the changes that they made between design and development and think about why they made those changes. If they kept written notes while they were developing the database, they should refer to these to help in the process. Ask learners to justify their choice of relational structure, referring to their notes. Reviewing and discussing the process of normalisation, creating the ERD and then the data dictionary may help some learners understand the process better.

- Learners need to consider the quality, performance and usability of their databases. It may benefit learners to have them review each other's databases or, alternatively, present their database to the class (this will work better if, as suggested, not all learners follow the same case study at the same time). This approach may work particularly well for evaluating usability, as it is quite hard for a product's creator to judge its usability. However, when it comes to the assessment, learners must evaluate their own products so they need to learn to be critical of their own creations. One way you can facilitate this is to ask learners to write an evaluation of their database then ask others to critique the database and the evaluation.

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

Pearson BTEC Level 3 Nationals in IT (NQF):

- *Unit 1: Information Technology Systems*

NQF Level 3 BTEC in Computing (NQF):

- *Unit 18: Relational database development*

## Resources

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

**Textbooks**

- Connolly T and Begg C – *Database Systems: A Practical Approach to Design, Implementation, and Management, Sixth Edition* (Pearson, 2014) ISBN 9781292061184.
  This is a comprehensive book on database systems and management.

**Websites**

- www.Support.office.com
  The official Microsoft Office website – it contains training material for various versions of Access.

- www.oracle.com/uk/index.html
  The Oracle database documentation, which includes information on database concepts.

# UNIT 3: USING SOCIAL MEDIA IN BUSINESS

## Delivery guidance

### Approaching the unit

Social media is an invention of the internet age. Nothing like it existed before, but its influence now is huge and it is an exciting, dynamic area.

This unit contains a number of challenges. Firstly, learners are likely to know a great deal about social media from their personal use of it, perhaps even more than you. You will need to emphasise that this unit is not about the personal use of social media but about its use by businesses for a variety of purposes. Secondly, it is a rapidly changing area – existing social media sites regularly have new features and adjust existing ones. New social media sites appear on a fairly regular basis, hoping to challenge the dominance of the existing successful ones.

You will therefore need to keep up with the latest developments, and ensure that among the large amount of information available on this topic from the internet, you are using up-to-date sources. (See, for example, the websites listed at the end of this delivery guide.)

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

### Delivering the learning aims

You should begin learning aim A with a review of social media sites, their features and how businesses use them. Learners are likely to be familiar with Facebook and Twitter but perhaps less so with the sites, such as LinkedIn, that are generally less popular with young people. Rather than teaching them about the features of these sites, use their existing knowledge to focus on business uses.

If you are able to get a visiting speaker from a local business to talk about how and why they use social media, this would be beneficial. A marketing manager (rather than an IT professional) would be a suitable visitor for this part of the unit, as they tend to implement social media strategies within businesses. You would need to brief the marketing manager by explaining the purpose of this unit and that your learners are studying IT rather than learning about marketing.

Learning aim B is about planning a social media campaign. There is quite a lot of marketing-related content and you might want to consider asking one of your centre's business or marketing lecturers to talk to your learners about marketing basics.

Learning aim B also focuses on understanding clients' social media requirements. This is another opportunity for you to invite a guest speaker to talk about working with clients. There are a number of possibilities – you could try to find someone from an advertising agency, or a marketing manager could talk about what, as a client, they would expect from someone planning a campaign for the company. Another possibility would be to ask learners to consider various companies, with which they are familiar, and ask them to think about what their

target audience is and how that might influence their approach to marketing and the media used. You could direct learners to the large amount of information available on the internet about planning social media campaigns – from simple hints and tips to detailed case studies.

Learning aim C focuses on implementing the social media plan and reviewing the results. You will need to organise simulation and practical tasks for this learning aim, as learners will need to perform research, produce and manage content, practise posting materials and review data and user feedback on the posts. Try to ensure that there are plenty of opportunities for review and feedback to help them develop analytical skills. You, other learners, and friends or family who are familiar with social media could be involved. Learners could, for example, set up a private Facebook group to allow other learners, friends and family to interact with them without involving the general public. It is unlikely that your learners will be able to access social media websites at your centre, so much of the practical work associated with this unit will need to be carried out by learners outside the classroom as homework. Learners could demonstrate their ability to set up posts and collect data about their followers by means of screenshots and printouts. Learners could present these to the class for discussion and feedback.

Throughout their practical work, learners should be encouraged to keep a diary in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing their evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

| Learning aim | Key content areas | Recommended assessment approach |
|---|---|---|
| **A** Explore the impact of social media on the ways in which businesses promote their products and services | **A1** Social media websites<br><br>**A2** Business uses of social media<br><br>**A3** Risks and issues | A report that explores how a business can use social media to raise its profile and promote products and services. |
| **B** Develop a plan to use social media in a business to meet requirements | **B1** Social media planning processes<br><br>**B2** Business requirements<br><br>**B3** Content planning and publishing<br><br>**B4** Developing an online community<br><br>**B5** Developing a social media policy<br><br>**B6** Reviewing and refining plans | Documentation showing the planning, preparation and implementation of the use of social media in a business, which meets identified requirements.<br><br>Established social media pages dedicated to the business, which fulfil the requirements given in the plan, accompanied by supporting documentation.<br><br>Statistical data generated by social media websites, including an analysis of how it was used to optimise the use of social media.<br><br>A report evaluating the use of social media in a business against the plan, showing how well it meets the business requirements. |
| **C** Implement the use of social media in a business | **C1** Creating accounts and profiles<br><br>**C2** Content creation and publication<br><br>**C3** Implementation of online community building<br><br>**C4** Data gathering and analysis<br><br>**C5** Skills, knowledge and behaviours | |

## Assessment guidance

This is an internally assessed unit and learners will need to complete two internally devised and marked assignments to cover the learning aims.

For learning aim A, learners could produce a report covering the criteria, although, given the unit topic, electronic delivery (such as via a blog, wiki or audio/visual evidence) might be more relevant, provided the information is communicated in a clear and detailed manner using appropriate language. Learners may want to refer to various internet-based examples of how businesses have used social media, and these can be linked to a blog, wiki or other type of electronic document.

With so much material freely available about social media on the internet, remind learners about plagiarism. Linking to websites and citing fully referenced quotations is fine, but copying and pasting text directly from an internet source is definitely not.

Learning aims B and C are assessed together through a single assignment based on a simulated or real-world marketing problem. The scenario should be of sufficient detail and complexity to cover the scope of the specification and allow learners to explore different solutions and attain success at all grade levels.

Learners will need a 'client' to help them understand the requirements of the campaign, and this is likely to be you, although it may be possible for learners to use links with local employers. Learners will also need an online 'audience' to respond to their campaign posts. Although it may limit the realism, it is probably best if learners largely perform this role for each other. Encourage them to play their roles as realistically as possible, responding to posts as they would in reality. Given the simulated nature of the task and the limited time available to post and respond to comments, the data available for analysis might not be very realistic. However, learners should still be able to comment on and evaluate the information.

# 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 3: Using Social Media in Business |
|---|

### Introduction

Given the dynamic nature of this topic there are many opportunities for research. Learners can also draw on their personal experiences as the 'audience' for social media business promotions. Make sure, however, that you remind learners that this unit is not about personal use of social media and focus your teaching on social media in business. It is unlikely that learners will be able to access social media websites from your centre, so much of the practical work and data gathering will need to be carried out by learners outside the classroom as homework/independent study.

### Learning aim A – Explore the impact of social media on the ways in which businesses promote their products and services

Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- You could base much of the delivery of this learning aim on asking learners to carry out research into how different businesses use social media. Due to the dynamic nature of social media, you will need to use current examples for this. Try to find examples from a wide range of companies (large, small, local, national or international) selling different types of product and services and using social media in different ways (including using different social media sites). For example, Toyota and Butlins, Domino's Pizza, Tesco, Nando's, Three Mobile, Nike and Redbull could give learners some interesting case studies. Each of these have had, and continue to have, a successful social media presence.

- Give learners opportunities to visit the websites listed in the Resources section of this guide – these contain information about using social media for business and marketing purposes.

- One way you can help learners develop the evaluative skills required for the higher grades is to set them a project to research. Ask them to select their favourite social media campaign and then present it to the group, giving reasons why it is their favourite. It is important to remind learners that they need to choose their favourite campaign, not their favourite product, and that they must give clear, detailed reasons as to why it is their favourite. Ask them to compare their favourite campaign with their least favourite, explaining how one engages their interest and why the other fails to.

- If you can arrange a guest speaker, this would be very beneficial. The ideal speaker would be from a small, young company that has used social media to promote their business. If you cannot get someone to visit in person, try to set up a Skype session for a speaker to give a remote presentation and answer learners' questions. Brief the speaker on the sort of topics they should cover, such as how they use social media in their business, what they find effective (and ineffective), the risks and issues of using social media and the ways that the business deals with them.

### Learning aim B – Develop a plan to use social media in a business to meet requirements

As an alternative to the guest speaker for learning aim A, you could arrange for a guest speaker with some knowledge of marketing to talk to the learners about marketing a

business using social media, and to explain how to identify and engage a target audience. Alternatively, try to find a marketing manager or someone from an advertising agency to talk to learners, either in person or remotely. Brief your speaker carefully about what should be covered, and ask your learners to prepare questions to make the most of the session.

- Ask learners to complete a case study project to develop their planning skills and practise creating engaging content. Each Jobcentre in the UK has a business mentoring service that gives business support to new business start-ups on the government's NEA (New Enterprise Allowance) initiative. This means a potential pot of new business start-ups where learners could be engaged in helping the individuals with their social media for business strategies may be available. For example, someone starting out as a technical author, taxi driver or catering service etc. Prior to starting on the case study project, you could have a number of smaller group activities looking at the concepts of planning a social media campaign and developing engaging content including reviewing and evaluating the effectiveness of content examples. Once the introductory activities have been completed, split the learners into small groups and either give them, or ask them to select, a social media campaign to plan. Each group should use a different case study – there is a wide range to choose from. The campaign could be to raise awareness of a business, promote a newly founded business, or promote a specific product or service. The business needs to be imaginary but, ideally, it should be a commercial company. It could be a charity, music group/band, or other business run on a commercial basis. However, it should not be an individual. This project will be invaluable preparation for the live assessment, so encourage learners to take notes and make sure that all group members are fully engaged in the process.

- To help develop learners' reviewing and evaluating skills, organise a review panel for the end of the delivery of the learning aim so that learners have an opportunity to present their social media campaign. Getting the panel together is the main challenge – you will need to find either subject experts or members of the public who use social media. You could, for example, ask one or two second-year learners to join the panel, or any adult who is a regular social media user. In terms of experts, a member of the business studies teaching team or a local businessperson would fit the bill. Ask the groups to produce a short presentation on their plan that focuses on their target audience and how they will engage with them. The review panel will give feedback on the plan and suggest improvements. It is important that the groups listen carefully and take notes to get the maximum benefit from the process.

## Learning aim C – Implement the use of social media in a business

Learning aim C focuses on learners implementing the plan they have created and analysing the results. It is important to build up learners' skills and knowledge before they begin work on the assignment for this learning aim – you should not use the assignment as a vehicle for teaching the content.

- Help your learners to understand connections between a business' social media presence and its website and other media exposure. This should be in terms of having consistent branding across all media (styles, fonts, colours, logos etc) and in the links between the website and social media sites. Working in small groups, learners can research examples of how real businesses do this and then present their findings back to the whole class.

- This research should be broken down into small tasks so that all learners have the opportunity to research the use of social media by a range of organisations, including their target audiences.

- Help learners to develop their skills by encouraging them to evaluate how effective the business' use of social media is by means of discussions and the use of probing

questions to ensure that they consider the issues in sufficient depth.

- You could also ask learners to set up a web page/website for the imaginary business for which they are running the social media project. This would further help the New Enterprise Allowance start-ups mentioned in learning aim B. If learners are also completing the website development unit (*Unit 6*: *Website Development*), then there is a possibility of linking the two. Alternatively, learners can set up a simple website using, for example, Google's Blogger blog page creation tools. They can also use this site to investigate the use of Google Analytics.

- Split the learners into small groups and give each group a different business that has made extensive use of social media. Any unused examples from the previous case study list could be considered, such as Toyota and Butlins, Domino's Pizza, Tesco, Nando's, Three Mobile, Nike and Redbull. Each of these have had, and continue to have, a successful social media presence. Each group should look at their business' recent use of social media and discuss what their purpose might have been for recent postings (eg direct advertising, brand development, encouraging likes) and how effective they have been (based on the number of likes and comments postings have achieved, and their own opinion). The groups can also look at how well the business' social media efforts are linked with their website. Once the investigation is complete, learners can prepare and give a short presentation to the rest of the class reviewing what they have found and they could also attempt to evaluate the effectiveness of the approach the company has taken.

- Allow each group of learners the opportunity to research several social media campaigns, rather than focusing on only one type of business and audience profile, before they tackle a mock assignment. That way, they will be more thoroughly prepared for the actual assignment.

- Given the practical nature of this learning aim, it makes sense for learners to develop these skills by continuing with the social media campaign they started in learning aim B. Set up a simulated activity that requires learners to take the role of social media users interacting with the posts made by other groups. This, of course, will limit the realism of the project, but, given the timescales and the nature of the exercise, there is not really an alternative. Brief the learners carefully on how to run the simulation, asking them to, as far as possible, behave as they would if it were a real activity. Set some ground rules about how they will be expected to interact with the imaginary business. This project is a very important 'practice run' for the live assessment and gives you an opportunity to resolve any issues and check learners' understanding.

- As mentioned above, learners developing skills for reviewing and evaluating the process and outcomes is important for obtaining higher grades and for progression to higher education. Once they have completed the social media campaign project, ask learners to prepare a presentation on what went well, what did not go so well and how they might change things next time. This will also help prepare learners for the live assessment. Encourage the whole class to comment on each group's project and to give constructive criticism. Remind learners that they must optimise their social media content to meet merit criteria. Feedback from others should help them see how to do this.

- It will benefit learners to maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.

- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

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

Pearson BTEC Level 3 Nationals in Information Technology (NQF):

- *Unit 1: Information Technology Systems*

- *Unit 2: Creating Systems to Manage Information*

- *Unit 6: Website development*

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 8 Business applications of Social Media*.

## Resources

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

### Websites

- www.socialmediaexaminer.com
  Social Media Examiner is one of many blog sites with up-to-date articles about using social media for business purposes.

- www.socialmediatoday.com
  Social Media Today focuses on social media marketing for business.

# UNIT 4: PROGRAMMING

## Delivery guidance

### Approaching the unit

This internally assessed unit has been designed to give your learners the opportunity to explore the concepts of computer programming as well as its implications and applications in a vocational context. You will be teaching learners to apply analytical thinking skills by considering the use of different programming paradigms to solve problems and create solutions. By the end of the unit, learners should be able to consider the needs of a client and develop solutions to meet a set of identified requirements.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

### Delivering the learning aims

For learning aim A, you could start by exploring the concepts of computational thinking. Initiate a class discussion about how these concepts are applied to the process of problem-solving and computer programming. Put learners into small groups and ask them to examine how to apply computational thinking skills to a given concept or problem. Learners should consider how different software is used to solve different problems. You should give learners a wide range of example programs, code bases and problems to investigate, to which they will need to apply analytical and computational thinking skills. For instance, learners could start by identifying common trends in a particular type of program and the ways in which these needs are met. Learners should explore different programming paradigms, in high-level and low-level programming languages, and how they are used to solve a range of problems. You could start by examining the principles of each paradigm, the functions that it offers and its benefits and drawbacks. It would be beneficial for learners to explore actual code that follows a specific paradigm. Learners should be given the opportunity to explore, change and develop the given code in order to see the implications of effective and less effective code.

Allow time in your sessions for learners to explore common programming constructs, functions and logical and mathematical principles. It may be beneficial to explore these in general terms using pseudocode before applying them to different languages and paradigms. Ask learners to compare the performance of different programming languages, programming techniques and different types of program/solution using testing methodologies and benchmarking tools. Give them access to examples of programs and code bases written in a range of languages. Open-source projects and communities could be good sources for appropriate material.

For learning aim B, you will need to ensure that learners have a sound understanding of the application of the principles and process of the software development lifecycle. Learners are not required to follow a particular model, although they may need to discuss the processes that they choose to use when evaluating their performance and solution. You will need to help learners to develop practical project planning and management skills in a vocational

scenario. When preparing for the assignment, you should ensure that learners are familiar with producing clear documentation and effective plans for all stages of developing a software solution. Learners should be able to communicate ideas effectively and be aware of the conventions and expectations of communication in professional, vocational scenarios.

Before starting the assignment, learners will need to have a good understanding of programming principles and their application in different programming paradigms. Ensure that learners are given the opportunity to practise creating different programs to meet a range of identified needs before attempting the final assignment. Ideally, learners should practise applying a range of different programming languages so that they are able to effectively select and apply a suitable paradigm to solve the problem presented in the assignment.

Learning aim C requires learners to demonstrate appropriate testing and review methodologies. You should ensure that learners have a good understanding of selecting and applying different testing methods, creating and completing test documentation and working with others to review and refine solutions. There is an opportunity for learners to test each other's solutions as users and/or as critical technical experts, particularly if access to a wide variety of testing subjects is an issue. Learners should be able to review the success of a solution, and their own performance, against the project success criteria. When reviewing the quality of outcomes, encourage learners to draw upon a range of sources including feedback from others, outcomes of testing and the notes that they have made throughout the development that give details of the process.

Throughout their practical work, learners should be encouraged to keep a diary, in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progressing to higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcomes, including their own skill, knowledge and behaviours.

| Learning aim | Key content areas | Recommended assessment approach |
|---|---|---|
| **A** Examine the computational thinking skills and principles of computer programming | **A1** Computational thinking skills<br><br>**A2** Uses of software applications<br><br>**A3** Features and characteristics of programming languages<br><br>**A4** Constructs and techniques and their implementation in different languages<br><br>**A5** Principles of logic applied to program design<br><br>**A6** Quality of software applications | A report evaluating computational thinking skills and how the principles of software design and computer programming are applied to create effective, high-quality software applications. |
| **B** Design a software solution to meet client requirements | **B1** Software development life cycle<br><br>**B2** Software solutions design | A project brief identifying the scope of the problem and user/client requirements.<br><br>Design documentation for the suggested solution.<br><br>User feedback and design refinement documentation.<br><br>Development and support documentation, including development and testing logs, meeting notes and a report that evaluates the outcomes and development of the project. |
| **C** Develop a software solution to meet client requirements | **C1** Software solutions development<br><br>**C2** Testing software solutions<br><br>**C3** Improvement, refinement and optimisation of software applications<br><br>**C4** Review of software solutions<br><br>**C5** Skills, knowledge and behaviours | |

## Assessment guidance

It is recommended that this unit is assessed as a maximum of two assignments. The first assignment should assess learners' understanding of learning aim A and the second assignment should cover learning aims B and C.

The assignment for learning aim A could take the form of an academic paper or report examining the use of computational thinking skills and programming principles in a range of languages and contexts. However, a blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language. The assignment brief should give enough scope for learners to explore how similar problems can be addressed using different languages and different programs. Learners will need to consider the impact that the implemented code has on the quality and appropriateness of the solution (ie program performance and whether it is fit for purpose).

The assignment for learning aims B and C should take the form of a practical project. Learners should plan, develop, test and review a software-based solution to meet the needs of a client. The scenario for the assignment should give enough scope to allow the learners to be able to consider different solutions and demonstrate a range of programming constructs. Learners will be expected to plan for and implement a range of testing methodologies to refine and optimise their solution. It is important that the context is realistic, and that learners have a 'client' for whom they are developing the system and whom they will work with throughout the project. The scope of the assignment should allow learners to show an understanding of writing computer software to meet specific, identified client requirements. To achieve a pass the program must function and broadly meet client requirements although some small, non-critical errors and inefficiencies may remain.

# 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 4: Programming

### Introduction

All areas of computing need people who are able to identify aspects of a problem and analyse the needs of users and clients to find a suitable solution. This unit gives learners solid foundation skills for deconstructing problems, planning and developing solutions, and applying the principles of computer programming to implement software that meets identified needs. These transferable skills will equip learners for further study or employment in the computing industry.

### Learning aim A – Examine the computational thinking skills and principles of computer programming

Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- You could begin by introducing the aim of the unit (ie the basic principles of computer programming and problem-solving) and how the concepts of computational thinking and programming constructs can be applied to practical problems. At first the problems should be more familiar to the learners using simple examples such as cooking a bowl of pasta, travelling from A to B or saving for a holiday. This should encourage learners to consider the wider issues such as what type of pasta, what quantity; what mode of transport, cost constraints; destination, length of holiday.

- Explain to learners that the four stages of computational thinking are decomposition, pattern recognition, pattern generalisation and abstraction, and algorithm design.

- Organise a variety of individual and group activities to allow learners to explore different software examples to analyse how computational thinking principles have been applied to produce solutions to problems. Database and spreadsheet examples will give learners a wide potential source of case studies.

- Ask learners to analyse a range of different software applications to examine how they fulfil the needs of the user and perform specific tasks and/or solve problems. You should give learners opportunities to compare programs with similar aims (eg different examples of a word processor) to see how common tools have been used and how the different instances vary in their ability to meet identified needs.

- Learners will need to understand the features, applications and implications of different high-level and low-level languages. You should give learners activities that focus on why a particular language may be used and the reasons for using it to create programs and other digital content.

- To develop learners' understanding of programming constructs, it may benefit them to start by looking at the sequencing of instructions, as this will allow them to explore the importance of identifying the correct order in which tasks should be carried out. Allow time for learners to work on this individually, or in small groups, looking at given problems. You could also give them examples of solutions that do not always present tasks in the correct order, as this would require them to identify what is wrong with the proposed solution and consider its potential impact.

- Learners should then explore programming constructs, and the logical and

mathematical structures that can be used to describe computer processes. It may be beneficial to introduce these topics using pseudocode as a way of exploring the concepts without the additional demand of learning the syntax of a particular language. However, as learners start to understand the concepts covered in the topic, you should start to show them how these concepts can be implemented within different programming languages.

- You could give learners sample code and ask them to explain what the statements in the code do. Allowing learners to experiment with given code to explore the effects of any changes they make will help learners to develop an understanding of how a language works.

- You should give learners access to examples of software developed in different languages and which uses a variety of code bases. Learners should analyse how the example code has been implemented, and evaluate the implications of the techniques and processes used.

- When exploring the quality of software applications, as well as considering the code base, ask learners to make use of testing, reviewing and benchmarking tools to assess how well a solution meets its aims.

- Learners should explore real life vocational contexts, where possible. Engaging with local employers gives a perfect vehicle for this. Organise guest speakers from, or visits to, local employers, if you can. If not, you could replace or supplement these with high-quality, factual case studies.

- You should work with learners to develop their analytical skills by exploring different vocational contexts and giving them opportunities to consider the requirements of a scenario and how the principles of computer programming could be implemented and the impact this would have.

## Learning aim B – Design a software solution to meet client requirements

Ensure that learners are equipped with a range of skills and knowledge before starting the assignment rather than using the assignment as a vehicle to teach the content.

- To begin the learning aim, introduce the software development lifecycle and the application of its principles and process. Learners are not required to follow a particular lifecycle model, but are required to demonstrate practical project planning and management skills in a vocational scenario. Prepare and distribute handouts for the learners. Documentation for this unit is likely to be extensive and could include, but is not limited to, project proposals, technical specification documents, flowcharts, algorithm designs (pseudocode) and test plans.

- To develop strong vocational skills, incorporate project management techniques into lessons to ensure that learners can manage projects effectively. Include organising meetings with the client, recording outcomes from meetings and other forms of feedback, and adjusting plans and timescales for the project as appropriate.

- You should work with learners to ensure that they can display effective and appropriate communication skills. Check that all project documents and communication with clients uses appropriate style, tone and content.

- Before starting the assignment, you will need to give learners a practical introduction to a range of programming languages. Learners will need to know how to implement programming constructs in a number of languages, in order to appropriately select and justify a particular programming paradigm to meet the needs of their client.

- Learners will need to be aware of how to document their testing, review and refinement process. Allow time to show learners how to effectively perform and

record ongoing testing, and seek and respond to feedback.

● Explain to learners that programs go through multiple stages of testing and refinement and therefore they should be aware of, and follow, appropriate procedures for recording changes and following versioning procedures.

## Learning aim C – Develop a software solution to meet client requirements

Understanding of this learning aim should flow naturally from learning aim B and learners will need to be able to apply this understanding as part of a larger project. As with learning aim B, learners should be equipped with a range of project management and programming skills before starting the assignment. The assignment should not be used as a vehicle to teach the content.

● You should give learners opportunities to explore a range of testing methodologies to develop their understanding of how and why computer programs are tested in different ways at different stages during the development process.

● Learners should be able to select and apply appropriate testing methodologies so that solutions can be thoroughly tested and reviewed. Ensure that they are able to appropriately and thoroughly plan and document the testing process.

● To develop understanding of the testing and review process, you could give learners opportunities to use pre-existing programs, for which they could plan (and carry out) testing and review procedures.

● You should aim to develop learners' evaluative skills. Learners should be able to use the outcomes of testing and review to evaluate the quality of programmed solutions (and their own performance, as appropriate) against project requirements and client expectations.

● You should work with learners to ensure effective and appropriate presentation skills. Emphasise the need for all project documents and communication with clients to use appropriate style, tone and content.

● The assignment should give learners a valid, vocational context. Try to organise a 'client' for learners to work with for the duration of the project, who will give them the operating requirements, set expectations and negotiate the timescales of the project.

● The client, where possible, should be a real-world client with whom the learner can engage. Although the project is simulated (ie it is not a live project), engaging with local employers to give a vocational setting would be invaluable. If you are not able to find real-world clients, ask another tutor or other adult to adopt the role of client. Other learners should not fulfil the role of client, although they could be test users. It is important that the client has a sound knowledge of the project and the related computing requirements

● Maintaining a diary or taking notes as they complete the various practical activities in the lessons relating to this learning aim will be of benefit to learners. They should also note the comments that their peers make when they give feedback.

● Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

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

Pearson BTEC Level 3 Nationals in IT (NQF):

- *Unit 1: Information Technology Systems*
- *Unit 6: Website Development*
- *Unit 7: Mobile Apps Development*
- *Unit 8: Computer Games Development*

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 14: Computer Games Development*
- *Unit 15: Website Development*
- *Unit 17: Mobile Apps Development*.

# Resources

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

## Websites

- www.python.org
  Python is an open-source programming language. The website has downloads for various operating systems and official documentation.

- www.w3schools.com/html/default.asp
  W3Schools - contains tutorials in web development languages, including HTML (with sections on HTML5), covering basic and more complex features.

- https://msdn.microsoft.com/en-us/library/2x7h1hfk.aspx
  Microsoft Developer Network – gives guidance for using Visual Basic, including language walkthroughs.

- www.microsoftvirtualacademy.com/en-us/training-courses/vb-fundamentals-for-absolute-beginners-8297
  Microsoft Virtual Academy – has a series of introductory tutorial videos on using Visual Basic.

- http://opensource.org
  The Open Source Initiative – gives help with open-source licensing and has links to various open-source projects.

# UNIT 5: DATA MODELLING

## Delivery guidance

### Approaching the unit

This internally assessed unit has been designed to give learners opportunities to explore the role that data modelling plays in the decision-making processes of businesses and organisations. Learners will need to use analytical thinking to analyse the various factors that affect a given scenario in order to develop a data modelling solution that will allow a client to consider a range of possibilities and make an informed decision.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

### Delivering the learning aims

For learning aim A you could start by introducing some of the concepts of the project lifecycle, including considering how this includes stages of the decision-making process (A1) throughout a project. You should then give learners opportunities to explore the use of data modelling in a range of vocational scenarios. This could be achieved by a combination of case studies, visits, guest speakers and individual research into a wide range of businesses and organisations.

As well as ensuring that learners understand the general uses of data modelling in a theoretical manner, you should equip them with a range of practical data modelling skills and create opportunities for them to use, evaluate and develop a range of effective (and not so effective) models for different scenarios. Ask learners to consider other scenarios at a more granular level, considering how specific features of a data model impact on the decision-making process and the accuracy and effectiveness of the final decision.

To complete learning aim B, you should ask learners to demonstrate a number of practical project planning and management skills. When preparing for the assignment, you should ensure that learners are familiar with producing appropriate planning documentation that is clear and detailed, and that they are familiar with effective methods of communicating with others to seek and record feedback in order to refine ideas.

In order to produce effective designs, learners will need a solid grasp of the features and limitations of data modelling software. Therefore, before starting the assignment, ensure that they have a good understanding of how to use data modelling software. Allow time for learners to experiment with creating and developing complex data models to meet identified needs and make decisions, in a range of realistic, vocational scenarios.

For learning aim C, learners will need to develop the practical skills listed in the specification (C1) in a range of realistic vocational scenarios. You should ensure that learners have a good understanding of selecting and applying different testing methods, creating and completing test documentation and working with others to review and refine data models. Learners should be able to apply and select testing methodologies that test the functional and acceptance

characteristics of a data model that they produce, and be able to review them against the required outcomes of a project.

Give learners opportunities to work with others to identify working parameters, success criteria and to review outcomes. It is important that learners can demonstrate that the can apply all skills in a realistic project environment. When delivering the content, it would benefit learners to engage with local professionals. You could organise guest speakers to give an insight into how modelling is used in larger projects or to show learners examples and case studies relating to the project management skills and decision-making processes required in the computing industry.

Throughout their practical work, learners should be encouraged to keep a diary, in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High quality and accurate verbal and written communication skills are vital for progressing in higher education and in employment. As such, ensure that learners are confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Demonstrate techniques to learners to help them effectively evaluate the success of a project and the factors that contributed to the final outcomes, including their own skill, knowledge and behaviours.

| Learning aim | Key content areas | Recommended assessment approach |
|---|---|---|
| **A** Investigate data modelling and how it can be used in the decision-making process. | **A1** Stages in the decision-making process<br><br>**A2** Spreadsheet features used to support data modelling<br><br>**A3** Using data modelling to consider alternatives<br><br>**A4** Evaluating models<br><br>**A5** Documenting and justifying decisions | A presentation or report evaluating the role of data modelling in the decision-making process. |
| **B** Design a data model to meet client requirements | **B1** Functional specification<br><br>**B2** Spreadsheet model design<br><br>**B3** Reviewing and refining designs | A practical activity, involving the design and development of a data model to fulfil identified client requirements.<br><br>A functional specification, design documentation, spreadsheet development and testing logs.<br><br>A report that evaluates the effectiveness of the alternatives considered and suggests ways in which the alternatives could be improved if the task were to be repeated. |
| **C** Develop a data model to meet client requirements | **C1** Developing a data model solution<br><br>**C2** Testing the data model solution<br><br>**C3** Reviewing and refining the data model solution<br><br>**C4** Skills, knowledge and behaviours | |

## Assessment guidance

This is an internally assessed unit and learners will need to complete internally devised and marked assignments to cover the learning aims. Learning aim A is essentially theoretical in nature and the assignment should be made practical by basing it around a vocational case study preferably for a real organisation. If there is an opportunity to involve an employer in helping to develop the brief then learners will clearly benefit.

The case study should have enough scope for learners to consider how data modelling is used in the decision-making process of a range of areas of the identified organisation, and why the identified data modelling is effective (or not) in meeting the organisation's needs.

Learners could present the evidence in a format of their choosing, but it should give enough detail and scope to demonstrate that they have carried out a thorough investigation. Evidence could be in the form of a written report, or a presentation (with slides and notes) to the company managers, which could be delivered to an audience and videoed. However, a blog or some other form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

For learning aims B and C, learners will need to design and develop a data model to meet the identified requirements of a client. Learners should have a 'client' for whom they are developing the model and whom they will work with throughout the project. The client should give learners a scenario that includes sufficient detail for them to meet the assessment criteria. This should include, for example, a clear description of the nature of the problem, functions that the data model must perform, the required user interface, any identified constraints and the criteria that will be used to measure success. Learners will need to put together a portfolio of evidence to show that they have designed a data model to produce initial spreadsheet designs according to a specification, and that, following review with clients and others, this has been refined to improve its effectiveness.

Evidence for final designs should include detailed worksheet structure diagrams and test plans. Having agreed the final design, learners must go on to develop and test their data model solutions. They must show evidence of reviewing and refining the solutions in the light of issues that arose during development and testing, client feedback and factors that could extend and improve the model. Evidence of refining the model may include annotated screenshots, videos or witness testimony. Learners should also include detailed test logs showing formative and summative testing for functionality and acceptance. Learners should give written or audio/visual evidence to show communication with clients and others throughout the assignment. In addition, learners must write up an evaluation of their own performance during the design and development process (eg planning and recording, evidence of response to outcomes and the impact of their behaviour).

# 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 5: Data Modelling |
|---|

**Introduction**

The aim of this unit is to give learners an understanding of the decision-making process and the role that data modelling (in particular, manipulation of complex spreadsheet models) plays in the process.

**Learning aim A – Investigate data modelling and how it can be used in the decision-making process**

You could begin learning aim A by introducing the overall aim of the unit. Explain that learners will be required to produce two assignments: one that concentrates on learning aim A and one that focuses on learning aims B and C. Learners should be equipped with a range of skills and knowledge before starting the assignments – the assignment should not be used as a vehicle to teach the content.

- You should give learners opportunities to explore the concept of the project lifecycle in a range of contexts, but with particular emphasis on the role that data modelling plays in this. Learners should explore the decision-making processes (A1) applied at the different stages of a project and the factors that impact on the accuracy and outcome of decisions.

- By organising case studies, visits and guest speakers, you can help learners to explore how the features of spreadsheet software can support data modelling, and how this can give a range of alternative options and assist decision making. You should give learners opportunities to apply and develop practical spreadsheet skills to build up a sound understanding of the underlying principles and to analyse how these functions are applied to real-world situations. Learners would benefit from exploring a range of bespoke modelling software (such as Quantrix®) as well as functionality in their generic software (such as Microsoft Excel®).

- Present a range of different models to learners and ask them to analyse them to identify how they fulfil the needs of users and perform specific tasks and/or solve problems. You should give learners enough information to enable them to compare models with similar aims (eg different implementations by different organisations) to see how common tools have been used, and how the different models vary in their ability to meet identified needs. There are many business situations that would benefit from modelling, for example cash flow forecasting to establish short and medium money availability for an organisation. 'What if' scenarios could be used to compare two budgets: costs and projected revenue values could be changed to find the most likely profit scenario for a particular situation. Goal seek could be used to find the optimum interest rate for a loan based on the loan amount, the repayments you can afford and the length of time that the loan is needed.

- Encourage learners to develop their analytical and evaluative skills by setting tasks that require them to explore the features, uses and implications of models and their related decisions within different contexts. Learners should understand how and why different processes are used and be able to select, and justify the selection of, different tools, data sources and data sets to meet identified needs.

**Learning aim B – Design a data model to meet client requirements**

Learners should be equipped with a range of skills and knowledge before starting the

assignment – the assignment should not be used as a vehicle to teach the content.

● For topics B1 and B2, explain to learners how to use a range of planning documents to identify user requirements and plan the scope of the data model. Documentation for this unit is likely to take the form of project proposals, functional specifications (including required data validation), time plans and worksheet and interface designs, although it may not be limited to this and may include other project planning aspects such as budgeting and testing requirements. Learners should understand the importance of these documents particularly as without them the evaluation process is compromised.

● To develop strong vocational skills, spend time making sure that learners can manage projects effectively. This could include organising meetings with a client, recording outcomes from meetings and other forms of feedback, and adjusting plans and timescales for the project, as appropriate.

● Work with learners to ensure that they develop effective and appropriate communication skills. All project documents and communication with clients should use the appropriate style, tone and content. Equal emphasis should be placed on written and oral communication skills and learners should have opportunities to formally present information, ideas and recommendations to different types of audience.

● Before starting work on the second assignment, you will need to ensure that learners are able to demonstrate strong practical skills in using your chosen data modelling software. Learners will need to understand the scope of the functions and tools available within the chosen software and be able to select and justify the use of these to develop a model to meet a client's needs. Learners should also be encouraged to use digital data sources to independently develop their understanding where their skills are lacking.

● It may be beneficial for learners to also spend some time exploring the concepts of good interface design and how the user interface (UI) of a computer system can have an impact on the user and the functionality of a data modelling solution. Ask learners to consider how an interface should be implemented to meet the needs of a range of users. Reviewing a range of UI examples will help learners to make judgements about what good and bad UIs look like. Learners should also understand that whilst there are best practice techniques for user design, subjectivity also has a part in it.

● Learners will need to consider the outputs from the system and the format that these will take. They should be aware that the format of the data output can affect the usefulness of the system and the quality of the decisions made.

## Learning aim C – Develop a data model to meet client requirements

Understanding of this learning aim should flow naturally from learning aim B, and learners will need to be able to apply this understanding to a larger project. Ask learners to explore a range of testing methodologies to develop their understanding of the commonalities and differences between the various methods employed to ensure the quality of a data model.

● Learners should understand how, when and why each is used, and should be able to select and justify the use of different methodologies in their own project. They must appropriately and thoroughly plan and document the testing process and they should understand how this process will contribute to the successful outcome of the project as well as the project evaluation.

● To develop understanding of the testing and review process, give learners access to pre-existing models and ask them to test and review them, in order to identify areas for development and improve the solutions. There are many models online that could be used for this activity and learners should be encouraged to explore a

range across sectors (such as engineering, business, or medicine as well as those for IT).

- Help to develop learners' evaluative skills. They should be able to use the outcomes of testing and review to evaluate the quality of data models (and their own performance, as appropriate) against project requirements and client expectations.

- Work with learners to ensure effective and appropriate presentation skills. All project documents and client communication should use the appropriate style, tone and content. Learners should also be shown how a range of communication styles and tools can be used in different combinations and contexts (such as giving out handouts containing acronyms for non-technical staff in a presentation).

- The assignment should have a valid, vocational context. For the duration of the project, ask learners to work with a 'client' who will give them the operating requirements, set expectations and negotiate the timescales.

- The 'client', where possible, should be a real-world client with whom the learner can engage. While the project will be simulated (ie it will not be a live project), engaging with local employers to give learners a vocational setting would be invaluable. Remember, it is likely that you will have ex-learners who may well have remained local and who will be in different places in their careers. Social media is useful for reaching out. If real-world clients are not a possibility, ask another adult to adopt the role of client. Other learners should not fulfil this role, although they could be test users. It is important that the client has a sound knowledge of the project and the related computing requirements.

- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.

- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

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

Pearson BTEC Level 3 Nationals in IT (NQF):

- *Unit 1: Information Technology Systems*

# Resources

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

## Websites

- www.eusprig.org/index.htm
  European Spreadsheet Risks Interest Group – has a range of skills training videos and academic papers on development of spreadsheets and data models.

- http://epublications.bond.edu.au/ejsie/
  Bond University – online/electronic journal on the role of spreadsheets in education.

- http://eusesconsortium.org/
  End Users Shaping Effective Software consortium – academic research and links to academic materials on end user software development including human user interface (Human-Computer Interaction) design.

# UNIT 6: WEBSITE DEVELOPMENT

## Delivery guidance

### Approaching the unit

This practical-based unit allows learners to understand the principles of designing and creating a functional website and focuses on the design and development of a website to meet the requirements of a client. Learners should be encouraged to seek out real-life situations where a website is required. For example, learners (or you) could approach local businesses. They could then explore the specific requirements, and begin to design and develop a website for that particular business. By using real-life scenarios, learners should be encouraged to design and develop interesting and creative websites. If this is not possible, you could develop simulated scenarios.

When approaching the unit, it is important to allow practical web-based exercises to hone learners' web design skills. For example, tutorials on hypertext markup language (HTML), cascading style sheets (CSS) and JavaScript® will enable learners to learn the necessary skills involved in developing a website. Learners should be encouraged to explore different software packages – for instance, rapid application development tools such as Dreamweaver. Alternatively, where this type of software is not available, learners should work from a text editor and a web browser.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

### Delivering the learning aims

For learning aim A, you could start by introducing the principles of website development. Begin with a class discussion that introduces the purpose and principles of website products. There are various concepts that learners need to understand, so there will be elements of tutor-led delivery where key ideas and principles will need to be explained.

The delivery, however, should be predominantly practical-based. Therefore, tutor-led delivery should be accompanied with exercises and independent research. Within learning aim A, there is scope for learners to research websites and give feedback on the purpose and principles of website products, as well as the different factors that affect website performance. Learners need to understand that website development is influenced by many factors and this can have a bearing on a website's overall performance and success. Encourage learners to present their research findings through class discussions, via online tools such as blogs or wikis, and as reports.

Learning aim B will need tutor-led instruction about the design concepts involved in producing websites. Design tools are crucial for showing clients what their website will look like when completed. Failure to produce a coherent design may mean that the end result will not meet the client's requirements. Therefore, when planning the unit, ensure that learners understand the importance of the design process, and that it should be undertaken in conjunction with the client. If a local employer in your area has the need for a website, try to arrange for a

guest speaker to discuss what their needs are so that learners can elicit requirements from them. In addition, try to arrange technical workshops involving staff from local organisations/businesses or opportunities for learners to observe working practice through visits or work experience.

Having discussed the requirements, learners should be able to develop appropriate designs to meet the client's needs. Teaching and learning should focus on developing learners' ability to produce clear and coherent designs and being able to articulate these. This will not be limited to a single design. Learners should produce and document a range of different designs for creating their websites. Learners will need to justify their final choice of design. You should also guide learners to identify the target audience and their requirements.

Learning aim C is a natural extension of learning aim B. Learners must be capable of developing a website to meet the needs of a client. It is important that learners fully understand the different skills needed to develop a website and have sufficient practice at applying them. One approach to delivering the content is for learners to work individually through exercises, for example workbook exercises on HTML, CSS and JavaScript®. This will ensure that learners are confident using the necessary skills. Allowing learners to work in pairs may help them to develop their skills quickly as they will be able to share their existing knowledge with others.

It is important that learners understand how to optimise a website and test its usability, interactivity and compatibility. To help with learners' understanding of these elements, they could ask for feedback on their designs from their peers and could give feedback to others. Learners should evaluate the feedback and make improvements, as necessary, to meet client needs.

Learners may work at different paces and their progress will need to be tracked and monitored. Differentiation opportunities are available for learners with prior knowledge: for instance, you could introduce and develop client-side scripting or HTML5.

You could encourage learners to apply the project management skills that they acquired in Computing, *Unit 3: Planning and Management of Computing Projects*, to their projects.

For learning aim C, you could invite back the guest speaker to appraise the work in progress. This is an opportunity for learners to talk to the guest speaker about what they have developed and for there to be a dialogue between 'designer' and 'client'. This is particularly useful for helping learners to develop their understanding of how to communicate and behave appropriately in more formal situations. The aim is for learners to utilise the techniques they have learned in order to develop an innovative and compelling website for the client. Solving real-world problems will help learners develop employability skills. For example, they will learn the importance of deadlines, communicating appropriately with clients and getting the client to sign off on what they have done. These are all skills that learners will need to develop within the industry during their working lives.

Throughout their practical work, learners should be encouraged to keep a diary, in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High quality, accurate written and verbal communication skills are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project

and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

| Learning aim | Key content areas | Recommended assessment approach |
|---|---|---|
| **A** Understand the principles of website development | **A1** Purpose and principles of website products<br><br>**A2** Factors affecting website performance | A report describing the different types and purposes of websites. This will include an explanation of the factors that affect website performance and mathematical principles used in website development. |
| **B** Design a website to meet client requirements | **B1** Website design<br><br>**B2** Common tools and techniques used to produce websites | Learners' devised design documentation arising from the identification of client requirements.<br><br>A digital version of the website product, including an observation record sheet and supporting documentation, such as scripts and annotated screenshots, to justify design decisions.<br><br>A report evaluating the design and the website against the client requirements. |
| **C** Develop a website to meet client requirements | **C1** Client-side scripting languages<br><br>**C2** Website development<br><br>**C3** Website review<br><br>**C4** Website optimisation<br><br>**C5** Skills, knowledge and behaviours | |

# Assessment guidance

This unit is internally assessed, so you have some flexibility about what assessment methodologies to adopt. The recommendation is to split assessment into two assignments. The first assignment should focus on the principles of website development and the second one on the design and creation of a website to solve a problem.

The first assignment requires learners to evaluate the principles of website design, and how these can be used to produce a high performance outcome that meets the needs of the client. One form of presentation could be a Word report. This type of assessment method is well suited for when learners need to explain a concept. Learners should be encouraged to present their report in a professional manner. For instance, learners should create appropriate headers and footers, use titles and subtitles, and present a conclusion at the end. Finally, any citations that the learners have made must be referenced fully. Microsoft Word® has excellent features to do all of this, and these could be explained in class prior to the assessment being released to learners. However, a blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

The second assignment should focus on the design and creation of a website. Learners should produce several different website designs, explaining how the finished designs meet the needs of the 'client'. If possible, try to find a real-life scenario for the learners to work on. There should be evidence of appropriate stages in the website design, such as mood boards and wireframes. Learners should produce an evaluation of finished designs against client requirements in a word-processed report. As part of the process learners could work together on the investigation that will lead to the design and implementation of a website prior to individually designing a solution to the same problem using different creative techniques. Learners could then compare the final outcomes and how they have met the client brief.

From their designs, learners must produce a fully functioning website that meets the needs of the 'client'. The website must be tested appropriately to ensure that it works and is fit for purpose. Consider different testing methods, such as user acceptance testing or black box testing, for this part of the assessment. Learners could upload their websites to a server for the assessor to mark and use a blog to review their final websites. This should be accompanied by a witness statement to authenticate that the learners have uploaded the work themselves, and their website is entirely their own. This would show that different assessment methods have been used creatively within the unit.

# 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: Website Development |
| --- |

**Introduction**

Developing a website can be crucial to any business or organisation and with so many different technology platforms, websites are now more accessible. This presents the website developer with more challenges as the website must be equally appropriate across different technologies (such as PC, tablet, smartphone etc). It is extremely important for a website developer to be able to produce a website that stands out and meets the needs of the client. The ultimate aim of this unit is for learners to understand how websites are developed, and for them to design and create their own websites.

## Learning aim A – Understand the principles of website development

This learning aim should ensure that learners understand the suitability of websites for their intended audience and purpose. Understanding the principles of website design will help learners develop high performance websites that meet client requirements. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

● You could begin by initiating a group discussion on the principles of website development. Note down suggestions on a flipchart or dry wipe board, and discuss each suggested topic in detail.

● Learners could state the different target audiences of websites – these could include social networkers, gamers or buyers. Explain how and why users are now more empowered by websites. Reasons might include the fact that websites are user-friendly, consistent, navigational, flexible and customisable. This could lead into a research exercise in which learners have to explain (and cite examples of) web 1.0 and web 2.0 technologies. There is also scope to discuss the future of website development.

● It is important for you to explain the purpose and principles of website products. Specifically, learners need to understand how to use website design principles to produce engaging websites. You could highlight 'good' and 'bad' websites and cite what principles are being used in each case, for example use of white space, typography, colour or consistency. Divide the group into pairs or small groups and ask each group to identify and explore poorly designed websites and compare these with examples of innovative/creative websites. Their judgements should be based on the principles of website design that you have explained.

● Give learners plenty of opportunities to do practical-based work. For example, when citing what web 2.0 technologies are, each learner could upload and define a technical term to a VLE glossary. This gives learners a real-life example of how web 2.0 technologies can be used.

● Work with learners to develop their analytical and evaluative skills. Explore a variety of different website designs for different purposes and give learners opportunities to consider the requirements of each.

● Ensure that learners understand how to produce the detail required to achieve the highest grade bands in the assessment.

## Learning aim B – Design a website to meet client requirements

This learning aim is particularly well suited to learners who want to demonstrate their creative flair and individuality. Give learners practical tasks that ask them to produce different designs to solve a range of problems. Learners need to investigate these problems and develop appropriate designs. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

● Give direct input to learners about the different ways in which a website developer can design websites particularly in relation to different potential future audiences. Use question and answer techniques to check learner understanding. This should then lead into practical exercises that the learners need to complete.

● Give each group of learners a differently themed website, for example an information site, a site linked to a sport or other activity, a blogging site or food site. Ask them to work through the appropriate stages of design for their site. This must include mood boards and wireframes.

● Ask learners to show their designs to the rest of the group in the form of a presentation. Consider giving some kind of reward to the group of learners who develop the most innovative design. This should help motivate learners when they do their research and design.

● If possible, enlist the help of a local business with a digital marketing team. Ask if one of their marketers could come in and pose as a client. They should outline why they require a website, and learners could design and develop a website for them. A real-life situation should motivate learners to produce a design of the highest possible standard that meets the needs of their client.

## Learning aim C – Develop a website to meet client requirements

Learning aim C should give learners the tools they need to create a website from scratch. Give learners exercises to work through sequentially. Start by teaching the basics, such as how to develop a simple 'Hello World' website, and develop from there.

● Start by leading a discussion on the tools and techniques available to develop websites and link them to real examples. Explain the software that learners will be using to develop their websites. Learners should explore the advantages and disadvantages of rapid application development website tools and compare them with using a simple text editor.

● When you are confident that learners understand the key concepts involved in designing a website, decide how you wish your learners to create their websites. They could use web-authoring tools or code their websites manually using a web browser and notepad.

● It would be advantageous for learners to work through website creation exercises that hone their skills in HTML, CSS and JavaScript®. Exercises should initially be relatively simple, for example developing a basic website, and then progress to harder tasks that challenge learners' creativity. Learners should demonstrate their understanding of website scripting by tracking their progress and using appropriate question and answer techniques to check their understanding.

● In the second assignment, learners have to actually create a website based on their designs from learning aim B. They will need to optimise their designs, test the website appropriately and review the extent to which it meets the client's requirements.

● It will benefit learners to maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.

● Ensure that learners understand how to fulfil the assessment criteria for the pass,

merit and distinction grades.

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

Pearson BTEC Level 3 Nationals in IT (NQF):

- *Unit 1: Information Technology Systems*
- *Unit 3: Using Social Media in Business*
- *Unit 4: Programming*
- *Unit 7: Mobile Apps Development*

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 3: Planning and Management of Computing Projects*
- *Unit 10: Human–Computer Interaction*
- *Unit 11: Digital Graphics and Animation*
- *Unit 12: Digital Audio*
- *Unit 13: Digital Video*
- *Unit 17: Mobile Apps Development*
- *Unit 22: Systems Analysis and Design*
- *Unit 25: Web Application Development*

The previous QCF Level 3 BTEC National in Computing also has units that link to this and resources produced may be suitable for use in this unit.

## Resources

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

### Textbooks

- Flanagan D – *JavaScript: The Definitive Guide (Definitive Guides), Sixth Edition* (O'Reilly Media, 2011) ISBN 9780596805524.
  This is a useful guide on how to use client-side scripting within websites to produce interactivity and ultimately engaging websites.

- McFarland D – *CSS: The Missing Manual, Fourth Edition* (O'Reilly Media, 2015) ISBN 9781491918050.
  An excellent book on how to use HTML and CSS to produce clean, usable websites.

- McGrath M – *HTML5 in Easy Steps, Seventh Edition* (In Easy Steps Limited, 2011) ISBN 9781840784251.
  This book simply conveys how to apply HTML5 scripting to websites easily and efficiently.

**Websites**

- www.w3schools.com
  The w3schools.com website is a useful starting point for anyone who wishes to learn how to use HTML, CSS and Javascript to produce websites.

- www.codecademy.com
  Anyone can register on the Codecademy website. It includes free videos and training tutorials on how to develop websites.

- https://validator.w3.org
  Markup Validation Service (W3C) allows you to validate website content for free. This enables you to check for errors and ensure that your website is W3C compliant.

- www.webpagesthatsuck.com
  This website analyses good and poorly designed websites. You may find it useful for showing learners examples when explaining how to design clean, intuitive websites.

- www.csszengarden.com
  The CSS Zen Garden website allows anyone to explore different CSS templates which can be applied to a website design. You could show learners different styles of website layouts and how those layouts can be achieved using CSS.

# UNIT 7: MOBILE APPS DEVELOPMENT

## Delivery guidance

### Approaching the unit

In this unit, your learners will investigate mobile apps, the devices that they run on and the uses of apps in society. They will then go on to design and develop their own apps to run on mobile devices. As the mobile technology industry is booming and mobile apps are becoming increasingly important to many organisations, you should be able to identify plenty of real-life examples, guest speakers and relevant demonstrations to support your teaching.

Learners should have access to adequate mobile app development environments and mobile devices (such as those stated in the unit specification) in order to complete the assessment for this unit. Preferably, learners will have access to a selection of devices and environments as this will give them more opportunities for comparison with development options. You could also consider giving them access to online emulators to enable them to test the apps across a range of situations.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

### Delivering the learning aims

You could begin learning aim A by discussing how learners use their mobile phones. It is likely that most, if not all, of your learners will have smartphones. Learners could discuss the kinds of apps that they use and the different contexts in which they use them. This could lead on to a more general discussion about who uses apps and when and where they use them. Ask learners to consider why designers should ask themselves these questions. You could also ask learners whether they are more or less likely to use apps that are free, are free but have in-app purchases, or ones that they have to pay for. Is there, for example, a maximum that they would pay for an app?

Learners will need to have a good understanding of the different types of mobile app that are available (eg native, web and hybrid) and how they are implemented and used. When you are introducing the types of app and the contexts of their use, you could include the use of device functions within apps then move on to talk in greater depth about the way in which apps are integrated with a mobile device and what this means for designers.

Introduce your learners to programming and programming environments for mobile development as early as possible. Allow regular periods of time for them to work with development tools, especially if they have not yet done any programming in their other units. This will ensure that they understand the options available to them and practise their skills before starting work on learning aims B and C.

Throughout learning aims B and C, guide learners through the process of choosing appropriate methodologies that they could use in their designs. Learners should also be familiar with the different techniques used in app design and be confident in applying those that they will use in their own designs. When

designing their mobile apps, learners must be aware that, as with any software design, they should understand the scope of the design – what their design will include and what it will not include and why. They should also understand the importance of documenting this process to contribute to the final evaluation.

As far as possible, learners should consider their project in terms of the stages of software development, including analysis, design, development and testing. Give your learners as much time as possible to gain the practical skills that they will need to use in their own project, and teach them how to use the chosen environment. You should also make sure that they are able to make use of all of the techniques listed in the unit specification.

Throughout their practical work, learners should be encouraged to keep a diary, to record their progress, any issues they encountered and how they overcame those issues. This will be valuable for them when writing their evaluation and reflecting on their own performance as part of the second assignment.

High quality, accurate written and verbal communication skills are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

| Learning aim | Key content areas | Recommended assessment approach |
|---|---|---|
| **A** Investigate mobile apps and mobile devices | **A1** Types of mobile apps<br><br>**A2** Context of mobile apps<br><br>**A3** Mobile device integration<br><br>**A4** Mobile app programming | A report evaluating bespoke mobile apps running on different mobile devices.<br><br>An analysis of mobile device functions and the context in which mobile apps are used and an evaluation of the effectiveness of the implementation of mobile apps. |
| **B** Design a mobile app that utilises device functions | **B1** Requirements for an app<br><br>**B2** Designing a mobile app | Analysis, design and development of a mobile app. |
| **C** Develop a mobile app that utilises device functions | **C1** Content preparation for mobile apps<br><br>**C2** Developing a mobile app<br><br>**C3** Testing a mobile app<br><br>**C4** Lessons learned from developing a mobile app<br><br>**C5** Reviewing own skills, knowledge and behaviours | An analysis of context.<br><br>Product design documents.<br><br>A log of the development process, annotated code, screenshots of running app or demonstration of app running on a mobile device.<br><br>Testing documentation, including a test log, log of errors and any resolutions made. |

## Assessment guidance

The recommended assessment approach is to assess this unit using two assignments: one covering learning aim A, and one covering learning aims B and C.

The first assignment should ask learners to analyse mobile apps and the devices that use them and to discuss how the requirements of an app influence its design. They should also discuss the technology available in mobile devices and the impact that this has on the design and implementation of mobile apps. Learners should investigate at least one app that is implemented across multiple platforms (eg available on both Android® and Apple® devices). The report could be in the form of a written document, but a blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

The second assignment should ask learners to design and develop their own mobile apps. Learners will need to prepare their content (graphics, audio etc) for use on their targeted device and they should be encouraged to use assets developed in other units, where possible. By the end of the project, learners should have produced a functional mobile app with an associated development report.

# 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 7: Mobile Apps Development |
| --- |
| **Introduction** |
| Mobile devices are prevalent in our society, with many people possessing more than one, and the mobile technology industry is still growing. Nowadays, many software developments must be compatible with mobile devices. Almost all public-facing companies and organisations have an app for their customers. |
| As mobile app developers, your learners will need to analyse the device functionality required by apps and the capabilities of mobile devices. This will give them an understanding of the potential and the limitations of different mobile solutions. |
| **Learning aim A – Investigate mobile apps and mobile devices** |
| Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.<br><br>● Learners could begin by investigating apps that they are familiar with and some that you introduce. In a wider context learners could be canvassed for their opinion about whether some apps could be considered risky (for example apps that give a medical diagnosis or which claim to give advice and therapy to help users manage their mental health). Learners should be able to distinguish the type of an app (native, widget, game etc) and the context of an app (locale, utility etc).<br><br>● As learners need to have knowledge of several implementation options, you should give them examples of different types of mobile devices (eg phones and tablets, wearable technologies such as Apple® watches, and different operating systems and makes and models of device).<br><br>● Learners must understand the process of designing an app for use on a mobile device. Give them examples of good practice and case studies for development of mobile apps. You could discuss how developers discover the need for an app, what the type and the context of the app would be and how the functions of the device would be used. A good example to discuss is the concept of 'Hive®'. You should include a discussion about how plans are initiated and what should be taken through to the design stage (covered in learning aim B).<br><br>● Demonstrate some examples of mobile device functions, such as accelerometers, global positioning systems (GPS) and apps which can read ambient temperature. Discuss with learners how different apps might use these functions in different ways, and the implications that these functions have for the design and development of mobile apps. It would benefit learners to have access to devices with the functions that you demonstrate and discuss, so that they can investigate the uses of each function.<br><br>● Work with learners to develop their analytical and evaluative skills. Explore a range different devices and give learners opportunities to consider the requirements of each one. |
| **Learning aim B – Design a mobile app that utilises device functions** |
| To help learners to understand the theory behind mobile apps in context, you could refer to the apps, devices and functions identified in learning aim A. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not |

use the assignment as a vehicle to teach the content.

- In groups, learners could consider a range of scenarios and discuss the types of app that could be designed for each. Group discussions will help to generate ideas and give learners useful insights, even if they will ultimately work individually on their projects.

- Learners must be familiar with software development and the types of design documentation that they will need to produce and should understand the importance of documenting any design and development activity. Give learners real or fictional examples of the design process and documentation, and talk through the different stages of the process and the different features of the documentation.

- Learners will need to design the purpose, interface and algorithms for their apps. To this end, they should be confident in using diagramming techniques and pseudocode. To build their confidence, learners could investigate an app that is widely available and produce design diagrams and pseudocode to describe the app.

- Learners should present their designs to their peers for review, refining their designs as necessary in response to constructive feedback. This activity could be done a number of times throughout the design process, and you could organise it as a '*Dragon's Den*'-style pitch or as presentation-and-feedback sessions.

## Learning aim C – Develop a mobile app that utilises device functions

- Give learners samples of design schematics and demonstrate some of the steps in developing software from the schematics.

- Learners should have opportunities to create simple apps from given design schematics to enable them to build up their skills in using development techniques to create apps.

- Discuss what is meant by 'evaluating the effectiveness' of an app. You could get learners thinking about this by choosing an app that is widely available and identifying the requirements that it should fulfil. You could then ask learners to evaluate its effectiveness against these requirements.

- Ask learners to present prototypes of their apps to a small audience, perhaps as a small-group task. They should use appropriate tools and techniques for their app, such as programming constructs, event handling and device capabilities. Ensure that learners have experience of ongoing feedback and development of their products and ensure that they understand how they could contribute feedback to support the activities of others. Give learners opportunities to test, evaluate and refine products. Work with learners to develop time management skills to ensure a full development lifecycle can be applied to a product. This should be done late enough in the development for learners to have a functional app, but early enough for them to have time to make refinements based on the feedback they receive.

- Learners should understand the benefits and limitations of mobile devices in terms of effective preparation of content. This should be related to specific devices. You could put learners into groups where they will discuss a particular device or type of device (eg Apple iPhone® devices or Samsung Galaxy® devices) in terms of its benefits and limitations. Each group could then present their findings to the other groups.

- Learners should test their mobile apps for functionality, compatibility, usability, performance and acceptance. Their testing should go beyond their own testing activities or using learners in their group to test their apps. They should perform these tests using a variety of methods, such as white-box testing and black-box testing. They should rectify any issues that arise from these tests.

- As the development process continues, learners should demonstrate their apps to a larger audience and gather feedback from sample users to identify potential

improvements and the overall level of acceptance. This could form the basis for their evaluation of their app with regard to requirements and user feedback.

- Throughout the learning aim, ask learners to self-reflect on their performance and their overall approach to the tasks that they complete. You could encourage them to use tools such as SWOT analysis to identify their strengths and any areas for improvement.

- It will benefit learners to maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.

- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

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

Pearson BTEC Level 3 Nationals in IT (NQF):

- *Unit 1: Information Technology Systems*

- *Unit 3: Using Social Media in Business*

- *Unit 4: Programming*

- *Unit 6: Website Development*

- *Unit 8: Computer Games Development*


Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 17: Mobile Apps Development*


## Resources

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

### Websites

- http://developer.android.com/index.html
  Android development portal.

- https://developer.apple.com
  Apple iOS development portal.

- https://dev.windows.com/en-us/
  Microsoft Windows development portal.

# UNIT 8: COMPUTER GAMES DEVELOPMENT

## Delivery guidance

### Approaching the unit

The purpose of this unit is to give learners practical experience of designing and developing computer games. Learners will spend time investigating the computer games industry before assuming the role of a software developer within the games industry and analysing popular genres to design and develop their own computer game.

Learners should have access to adequate game development environments (such as those stated in the unit specification) in order to complete the assessments for this unit. Preferably, they should have access to a selection of environments as this will enable greater opportunity for comparison with development options.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

### Delivering the learning aims

For learning aim A, you could begin by discussing computer gaming in general. Learners could talk about their favourite computer games and genres. You should be careful here as there is potential for learners to get carried away with talking about their favourite games. To this end, try to focus learners on **why** particular games are their favourites. What makes them come back to these games? This could lead to discussions about different kinds of player, which could include age range, gender or casual versus immersive gamers, for example. At this point, you could also discuss the different ways of producing games, for example mainstream publishers, indies or free-to-play.

After discussing games and genres, move on to how games are played. Do learners prefer multiplayer or single-player games? Discuss multiplayer systems and the way they are implemented and maintained. Talk about how this leads to distribution platforms and integrated services, such as Steam and Google® Play Also, discuss concerns relating to multiplayer platforms such as how they can be kept secure. Initiate discussion about the way in which single-player games are implemented. Talk about how developers create convincing artificial intelligence.

Learners should investigate the hardware and software technologies available for use in computer games and what difference they can make to their design, development and distribution. Explain the benefits and limitations of different platform options for developing computer games. Learners should discuss what effect new technologies have on the computer games people play and how this affects the design and development of these games. Discuss the uses of game engines, their capabilities and the way in which they help computer game developers.

If possible, invite guest speakers from game developer studios to convey the current state of development processes and emerging areas. This should help highlight the need to keep up to date with technology.

In learning aim B, learners design a computer game. As with any software design, they should be familiar with the scope of the design. You should guide learners in the process of choosing appropriate models to use in their designs. Learners should be familiar with techniques used in game design and be confident in applying the ones that they will use in their own designs.

Throughout this learning aim and learning aim C, impress upon learners the stages of software development, including analysis, design (in learning aim B), and development and testing (in learning aim C). Ensure that learners understand what is required in analysing and designing a computer game, and in managing a software development project. You could encourage them to apply the project management skills that they acquired in Computing, *Unit 3: Planning and Management of Computing Projects*, to their projects.

Set aside time for learners to review their designs with their peers and, if possible, practitioners. They could do this through presentations or seminars, where they could ask questions and make suggestions for improvement.

In learning aim C, give learners as much practical experience as possible. Introduce the use of development environments early on and allow learners time to experiment with the tools available. Ensure that you give learners the opportunity to develop their skills using their chosen environment so that they can make use of the advanced features listed in the unit specification.

In learning aim C, learners complete their development projects. You should ensure that they are proficient with the development and testing stages of software development.

Allow time for learners to review their own draft computer games and those of their peers. Try to do this late enough that the learners have working games, but early enough that they will have time to make refinements based on the feedback they receive.

Throughout their practical work, learners should be encouraged to keep a diary, in which they can record their progress, any issues they encountered and how they overcame those issues. This will be valuable when writing their evaluation and reflecting on their own performance as part of the second assignment.

High quality, accurate verbal and written communication skills are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

| Learning aim | Key content areas | Recommended assessment approach |
|---|---|---|
| **A** Investigate technologies used in computer gaming | **A1** Social trends in computer gaming<br><br>**A2** Technologies used in computer gaming | A report investigating and evaluating social and technological trends in gaming and how they would influence the development of new computer games. |
| **B** Design a computer game to meet client requirements | **B1** Computer games design processes and techniques<br><br>**B2** Design documentation<br><br>**B3** Reviewing and refining designs | A design specification showing the design and development of a computer game to meet identified client requirements.<br><br>Project brief, design documentation, development and testing logs, meeting notes and a report that evaluates the effectiveness and appropriateness of the computer game. The evidence should also suggest ways in which solutions could be improved and/or alternative solutions that could be used if the task were to be repeated. |
| **C** Develop a computer game to meet client requirements | **C1** Principles of computer games development<br><br>**C2** Developing computer games<br><br>**C3** Testing computer games<br><br>**C4** Reviewing computer games<br><br>**C5** Quality characteristics<br><br>**C6** Skills, knowledge and behaviours | |

## Assessment guidance

This is an internally assessed unit. The recommended assessment approach is for two assignments.

Assignment 1 should cover learning aim A. The assignment should analyse computer games, and the trends and technologies that exist within the industry. It should also discuss emerging trends and technologies, for example the developments in wearable technologies, and their impact on computer games development. The assignment could be delivered as a website or as part of an ezine. However, a blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

Assignment 2 covers learning aims B and C. This assignment should be project-based, where learners design and develop their own computer game. Learners should try to use different assets (graphic, audio, animation etc) in developing their game. Encourage them to use assets developed in other units, where possible. Learners should deliver the assignment as a functional computer game with an associated development report.

# 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 14: Computer Games Development |
| --- |
| **Introduction** |
| Computer games are now developed for personal computers, consoles, mobile devices such as handheld consoles, phones, tablets and wearable technologies. With the spread of devices available for use, the computer games industry is continually growing and, as such, many computer game developments are as large a production as blockbuster movies, involving many contributors.<br><br>As game developers, learners will need to meet client requirements and understand the limitations and potential of different gaming solutions. |
| **Learning aim A – Investigate technologies used in computer gaming** |
| In learning aim A, learners will investigate computer games, genres and the technologies available to computer game developers. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.<br><br>● As learners consider and discuss games, they may start talking about gaming platforms, leading to the popular argument about which platform is best. Try to familiarise yourself with the arguments, so that you can dispel prevailing myths about specific platforms or technologies. Learners could also discuss their expectations of new gaming technologies such as the Xbox One S (released in August 2016), Xbox Scorpio, the PS4 Neo and new developments around the Sony PlayStation VR (released in October 2016).<br><br>● As learners discuss games and technologies, you can introduce technologies used in developing computer games. Learners need to gain knowledge and understanding about the hardware and software options available to game developers.<br><br>● If possible, demonstrate some game development technologies by showing some games in class (whether on PC, console or mobile device). At this stage, it would be useful for learners to see the process of designing and developing a simple game.<br><br>● Work with learners to develop their analytical and evaluative skills. Explore different areas of development (eg specific consoles, devices or genres of game) and give learners opportunities to consider the requirements of each one. |
| **Learning aim B – Design a computer game to meet client requirements** |
| When delivering learning aim B, you could refer to the popular genres and technologies identified in learning aim A, to help investigate how popular games were designed and how technology was employed. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.<br><br>● You should guide learners in the process of choosing appropriate models to use in their designs. Learners should be familiar with techniques used in game design and confident in applying the ones that they will use in their own designs.<br><br>● In groups, learners could build on earlier discussions to consider the type of games they would like to design. Whether learners do the design work individually or in groups, they will gain useful insight from group discussions. |

- Learners must be familiar with software development and the design documentation that is expected of them. They must be able to design the visuals, story, gameplay and algorithms for their game. To this end, they should be confident in the use of storyboards, diagramming techniques and pseudocode.

- Learners should review their designs with their peers and refine as necessary. Learners could present their design concepts for their computer games to the class and ask for comments and suggestions for improvement. They should make a note of any useful feedback given along with details of any refinements required.

## Learning aim C – Develop a computer game to meet client requirements

In learning aim C, learners develop their computer game from the designs created in learning aim B.

- Learners must know how to develop software from a design schematic, which should include how to apply graphical rendering and vectoring or add physics to their virtual environments. Learners should be able to produce a prototype of their games using appropriate tools and techniques. They should be able to use several game development environments, so that they can build up their skills.

- Learners should be confident in using game engines to develop visual styles. They should be able to optimise for certain input methods, integrate assets and include advanced features such as artificial intelligence, 3D rendering and multiplayer capabilities in their designs.

- Learners should be able to test their computer game for functionality, playability, compatibility and stability. These tests should employ a variety of methods, including white box and black box methodologies. Any issues should be rectified.

- Learners should demonstrate their game to an audience and gather feedback from sample players to identify areas needing improvement and the overall level of acceptance and playability.

- Having completed the process of development, learners should reflect on their performance. They should evaluate their computer game and their own approach to the project.

- It will benefit learners to maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.

- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

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

Pearson BTEC Level 3 Nationals in IT (NQF):

- *Unit 1: Information Technology Systems*

- *Unit 4: Programming*


Pearson BTEC Level 3 Nationals in Computing (NQF):
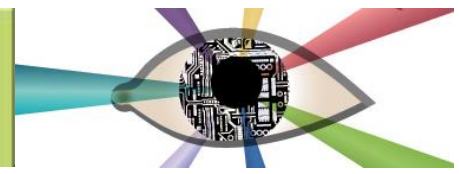
- *Unit 14: Computer Games Development*


## Resources

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

### Websites

- www.html5gamedevelopment.com/html5-game-tutorials
  Tutorials for game development in HTML5.

- https://unity3d.com/learn/tutorials
  Tutorials for the Unity game engine.

- https://wiki.unrealengine.com/Videos
  Video tutorials for Unreal Engine technology.

- http://sandbox.yoyogames.com/make/tutorials
  YoYo tutorials for game development in Game Maker.

# Unit 9: IT Project Management

## Delivery guidance

This mandatory unit for the Diploma and Extended Diploma is a real opportunity for learners to investigate the principles of project management and different project management methodologies. The reality of IT projects is that without structure and formal process, projects can flounder and fail; through this unit, however, you will support learners in developing a range of essential project management skills based on these five principles:

Initiating

Planning

Executing

Monitoring and controlling

Closing
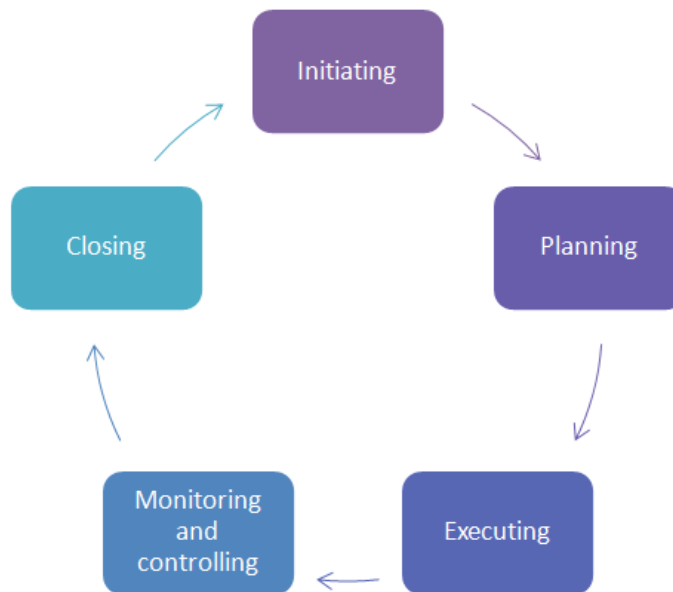
To deliver this unit, you will equip learners with the knowledge they need to help them make the right decisions and identify and use the correct tools in the right context.

Learners will develop investigative skills, drawing on other units to support their design activity and taking learning from units such as programming, computer games development, social media in business, graphics, mobile apps development, websites and animation to give them the technical skills they need to design and implement a solution.

If there are opportunities to involve local employers as clients, this will enhance the project and the learner experience.

It would be ideal if the class or course had a social media page, as this is a good way for learners to share some of their documented outcomes as recommended in this guide and the scheme of work.

## Approaching the unit

There are many examples of projects available to provide a business context for this subject, with examples of successful projects as well as ones that have failed. Both are valuable because they can be analysed against methodologies and best practice.

**This might include:**

- Projects where the project activity lost sight of the client brief.

- Projects where the client repeatedly changed the brief (often adding new functionality without understanding the impact that this would have on time and cost).

- Projects that were undertaken without stakeholder support and buy-in.

- Projects that were successful, coming in on time and on or below budget.

This unit would benefit from learners having access to IT project managers who could share their experiences and their 'lessons learned'.

### Learning aim A: Investigate the principles and methodologies of IT project management as used in industry

This learning aim investigates project methodologies and can be challenging to deliver as the topic can be a little dry, but it is essential that learners appreciate that there are multiple ways to approach and manage projects and that some techniques are more useful in certain situations than others.

Since the four methodologies to be studied have different approaches and characteristics, a good way of teaching this is to provide an electronic 'table' which learners will complete over the course of this topic and which includes some of the key points of comparison. For example, Rapid Application Development (RAD) is a methodology that has a high requirement for physical resources, prototyping and access to users. Therefore, this methodology might not suit a situation involving a large number of stakeholders and future users across a large number of sites as this would add to the cost. The waterfall methodology is intended to 'flow' towards completion, which means it can be difficult to backtrack to an earlier point (water only flows in one direction).

This topic can be brought to life with one or more guest speakers who work as IT project managers. The learners could ask general questions about the role and the types of projects that the managers have been involved with and then use their knowledge of the methodologies to ask directed questions about whether particular characteristics would have worked in the project manager's own activities. For example, 'How many users were involved?' 'What were the timescales?', 'What were the key challenges?', 'Did the client change the brief – if so, how – what was the impact on the project?', 'How many people were involved in the project team?', 'What roles did they assume?' and – an important question – 'What did the review highlight in terms of what could have been done differently?'. In addition, learners could be given a project scenario and asked to choose and justify which methodology would be the most appropriate.

Learners should understand that they need to be able to justify their choice of methodology and that this will be reviewed as part of the review phase of the project development process.

You could also investigate whether a representative from a training provider delivering PRINCE2® courses could visit and tell learners about the courses and certification (particularly as some learners may opt to study such a qualification alongside this course or after completing it).

The final part of this learning aim focuses on the roles and responsibilities of individuals involved in projects and project management across the whole spectrum. You could prepare for this topic by downloading some job descriptions for some of the roles, or by asking your employer contacts to provide some recent job descriptions that they have used in their recruitment.

### Learning aim B: Carry out a project initiation for an IT project

While it is likely that this learning aim will begin with an element of chalk and talk (or tutor-led PowerPoint presentations), learning should be reinforced through practically supporting the topic by giving a case study and allowing learners to put the theory into immediate practice.
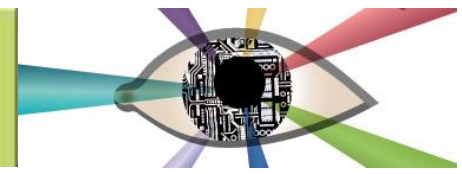
Good case studies could include projects such as:

- A booking system for technical support tickets for users visiting a local Apple store – this problem would have to manage advance requests booked online against store drop-ins.

- An online polling system for a TV show like Strictly Come Dancing, the X Factor or Britain's Got Talent – this problem would have to manage a reducing number of acts and possible carry-overs of votes from week to week.

- A search engine project to create a search engine with specific functionality (for example, a medical search engine or one for a specific hobby or interest) – this might have complex searching and sorting requirements using various algorithms.

- An interactive portal for a cloud-based storage company to manage technical questions from customers - many companies have Facebook and Twitter accounts and have to work within the constraints imposed by these social media providers.

To prepare this task, you would need to set criteria and either act as the client during the investigation, or invite another tutor or member of the technical support team to take that role.

Learners could then practise shaping the scope of the problem, carrying out a short feasibility study and setting project requirements. Learners should consider at least two possible solutions to enable them to make a reasoned judgement about the chosen solution. As this is a practice, the learner would not be expected to write reports and extended documentation, but should be able to present what they have learned about the problem and what they would include in a formal document.

You should consider asking learners to create and keep a reflective log where they can write down their reflections about the project process, as this will help greatly during any review (otherwise they may well forget important aspects of the project development). At a minimum, the log should record the week or date, activity and comments, and learners should record both what went well and what went badly.

### Learning aim C: Carry out the planning, execution, monitoring and controlling of an IT project, using an appropriate methodology

The topics in this section are relatively straightforward to teach in that they can be taught in part through small group and whole class discussion, placing some of the concepts in the learners' own context – particularly the topics of planning, risk assessment and the management of resources.

As this is the planning and implementation phase, the same case study used to support the practical aspects of learning aim B could be used to support learning here.

Learners focus on prioritisation (the ordering of activity, processes that can happen concurrently or where one process must be completed before another can begin), planning and risk assessment before executing the project and managing the process and the resources. The learners should not attempt to implement the whole project, but only part of it, adjusting timescales accordingly. This will ensure that there will be enough time available for the planning and implementation phase of the unit assessment.

### Learning aim D: Undertake the closure of a project by reflecting on the success of personal performance and the project outcome

The final part of this unit is the review phase. To support learning in this area, you should begin by using dictionaries (online or paper based) to define the word 'scope' so that learners understand the full implications of setting project boundaries so that the success or failure of the project can be measured and lessons can be learned.

A range of skills should be investigated. Learners should consider why time planning and management is essential not only for projects, but in general (for example on their course, or in a job situation).

This topic also requires learners to consider the behaviours of individuals involved in project management. Ideally, you should have two or three project management job descriptions available which outline the typical expected behaviours.

Learners should take part in a skills audit that helps them to identify their own strengths and weaknesses, and which gives learners an opportunity to discuss areas for personal development with either their unit tutor and/or their personal tutor.

**The approach to this unit should include the following aspects:**

- Practical aspects of this unit (excluding the unit assessment itself) would benefit from being linked to a single case study that forms the basis for the practical activity and enables learners to experience the flow of a project from project initiation to review and closure.

- Learners will benefit from reading around the subject with a view to finding examples of both successful and unsuccessful IT projects, which will develop an understanding of potential pitfalls and challenges.

- There is no requirement to use IT-specific project management tools, although it is recommended that learners use commercial project management software such as Microsoft Project or Zoho, or other products like Basecamp or Freedcamp as they would benefit from exposure to these tools.

- Guest speakers who work in an IT project management role would enhance the learner experience by giving real examples of theory put into practice.

- It would be beneficial to invite guest speakers who can introduce learners to an associated qualification, for example, professionals who understand Prince2®; contact details for the ILX Group have been included in the scheme of work.

- Projects chosen for both learning and assessment should be realistic but sufficiently challenging to stretch a level 3 learner.

- BTEC level 3 IT/computing qualifications have existed for approximately 30 years and it is likely that you will have alumni who are now practitioners or managers in the sector. It is likely that many of them would be willing to act as guest speakers or mentors for current learners if they are contacted through social media sites such as LinkedIn.

Assessment model (in internally assessed units)

| Learning aim | Key content areas | Recommended assessment approach |
|---|---|---|
| **A** Investigate the principles and methodologies of IT project management as used in industry | **A1** Project definitions<br>**A2** Characteristics of project management methodologies<br>**A3** Project management structures | A written report on the investigation of principles and methodologies of IT project management as used in industry, using at least three different IT projects as case studies. |
| **B** Carry out a project initiation for an IT project | **B1** Project idea generation and solution creation<br>**B2** Feasibility study<br>**B3** Project requirements | A project document portfolio created from implementing either a 'live' or 'simulated' project using an appropriate methodology. Evidence will include planning, preparation, feasibility studies, requirements and records of processes carried out during the planning and execution of a project. Written or verbal reports should accompany the evidence where clarifications and justifications are required, and versioned document control should be applied. |
| **C** Carry out the planning, execution, monitoring and controlling of an IT project, using an appropriate methodology | **C1** Project phasing<br>**C2** Typical project management processes | |
| **D** Undertake the closure of a project by reflecting on the success of personal performance and the project outcome | **D1** Lessons learned from implementing an IT project | A written report or presentation evaluating the outcome of the 'live' or 'simulated' project and reflecting on personal performance. |

## Assessment guidance

The assessment for this internally assessed unit would benefit from being divided into three assignments as shown above.

## Assignment 1 (Learning aim A):

A researched report focusing on three specific case studies about projects delivered using different project management methodologies.

- The case studies should be real rather than simulated and should be drawn from news articles or academic papers on the internet, IT professional/project management websites or interviews with businesses.

- The learners should use a referencing methodology and provide a bibliography.

- The report should:
  - show that the learner understands the key characteristics of the methodologies and how they have been applied to the IT projects.
  - explain the project management structures as applied to IT projects.
  - compare the merits of the methodologies (looking at the benefits and limitations of using a methodology) and evaluate their effectiveness and contribution to the success or failure of the project. This will enable learners to access higher grades.
- The report should follow a recognised format (either formal or informal) and should be presented as a professional business document.
- Learners will need to access a range of both published and online sources to provide the academic content.

## Assignment 2 (learning aims B and C):

The feasibility/planning/design and implementation phases of assessment will focus on a business scenario (preferably real rather than simulated). This would enable learners to interview their client to seek clarification about the project. The evidence should be pulled together as a portfolio, containing documentation and evidence as outlined below.

Using the scenario, the learners should:

- Undertake a feasibility study that should include the investigation of at least two possible solutions, one of which should be chosen for development.
- Demonstrate planning/design of the proposed solution using appropriate tools which may include benefits, diagrams, storyboards, flow charts and other technical information. Screenshots or printouts from project management software will also provide useful evidence.
- Consider risks and monitor the process to ensure quality.
- Implement and test the chosen solution appropriately, with relevant technical documentation produced.
- Apply version control to documentation.

## Assignment 3:

This assignment would benefit from being developed as a written report or presentation, with learners evaluating the outcome of the project and reflecting on their own performance.

The evidence should:

- Explain the knowledge and project management skills and techniques used by the learner in the development of the solution.
- Outline the behaviours demonstrated.
- Explore how issues were overcome and outline the lessons learned from being active in the process.

# Getting started

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

## Unit 9: IT Project Management

### Introduction

Introduce the unit using a combination of short YouTube videos, news articles and discussion. Learners will use the internet to find examples of IT projects that have either gone well or failed, which they will then share with the class. Learners should carry out an initial skills and behaviours audit to capture their assessment of their own skills. The audit should largely include generic skills and behaviours which would be relevant when contributing to or managing a project. It should also include an element of technical skills, although this can be achieved by simply providing a section where learners can list the technical skills they are good at. This process will be repeated at the end of the unit using the same document.

## Learning aim A / Topic A1 – Project definitions

- Define project and give examples of common IT projects.
- Present the phases of the project lifecycle.
- Guest speaker gives a presentation to learners on the role of a project manager, followed by an opportunity for learners to ask questions to clarify points and enhance their understanding of the role and its challenges.
- Learners explore project management software.

## Learning aim A / Topic A2 – Characteristics of project management methodologies

- Before embarking on this topic, give learners a prepared electronic table that will allow them to capture the key points of comparison (such as suitability against timescale or size of user group).

### Projects IN Controlled Environments (PRINCE2®)

- Guest speaker from ILX Prince2® to outline the main characteristics of this methodology. Alternatively, use the four videos listed in the Resources section of this delivery guide.
- Learners work in groups to explore one of the suggested UK organisational case studies (links provided in the scheme of work) and create a PowerPoint presentation focusing on the case study they were allocated, which they then present to the class.
- Using all of the research and resources used in previous activities, learners work in groups to create a visual media artefact that demonstrates their understanding of the Prince2® methodology.
- Learners make their own notes on the electronic table.

### Rapid Application Development (RAD)

- Tutor presentation on the principles, tools and techniques of RAD.
- Learners carry out individual research into CASE tools.
- Learners should work in small groups to investigate RAD tools in software development. A video that explains RAD in Delphi is provided in the scheme of work and learners will then explore the programming environments they use in class and the RAD tools available.
- Using all of the research and resources used in previous activities for this topic,

learners work in groups to create an audio media artefact that demonstrates their understanding of the RAD methodology.

- Artefact created in the final activity should be presented to the class for feedback.
- Learners make their own notes on the electronic table.

### Waterfall

- Learners carry out individual research into the waterfall methodology using one resource provided in the scheme of work, but finding an additional two sources to complete the activity.
- A tutor-led class discussion on one of the key disadvantages of the waterfall methodology follows, using a 10-minute video (which can be found on YouTube) illustrating scope creep, followed by further discussion and a 7.5-minute video that outlines strategies to avoid this risk in a project.
- Using all of the research and resources from previous activities for this topic, learners work in groups to create a text-based artefact that demonstrates their understanding of the waterfall methodology and, in particular, how client expectations need to be managed to stay within the constraints of the methodology during the project.
- Artefact created in the final activity should be presented to the class for feedback.
- Learners make their own notes on the electronic table.

### Agile

- Small group work to investigate the Agile methodology and the two key variations that are commonly used in industry. Learners prepare teaching materials to later teach other members of the class about the methodology they have chosen (or have been allocated). Some initial links to resources have been provided in the scheme of work.
- Learners use the teaching materials they developed in the previous activity to 'teach' the class.
- Learners make their own notes on the electronic table.
- You should ask learners to carry out a short activity (which could be delivered as a mini-project) in which they prepare a PowerPoint presentation to demonstrate their understanding of the Agile methodology, enhancing it with case studies were possible. The PowerPoint presentation should be presented to the class for feedback.
- To complete the topic, you could ask learners to write an article for a sector journal that formally compares the four methodologies. The completed article should be published on a class social media page.

## Learning aim A / Topic A3 – Project management structures

### User requirements:

- This is a relatively short but important topic and would be best delivered as a short PowerPoint presentation that stresses the difference between functional and non-functional requirements.

### Project job roles and responsibilities

- Small group activity focussing on investigating job roles for individuals involved in project development and stakeholders. Learners will collaborate within groups to create job descriptions (link to a sector-based professional website provided in the scheme of work). The completed job descriptions will be lodged in a job bank.

### Quality assurance, testing and deployment

- To complete the learning aim you will lead a discussion on managing project quality, project testing and deployment. Several links have been included in the scheme of work, providing the source materials to be used in the discussion.

## Learning aim B / Topic B1 – Project idea generation and solution creation

- In preparing for this topic, you should consider asking learners to create and keep a personal reflective log that they will use when they carry out a feasibility study, create project requirements and then plan, execute, monitor and control their IT project. While this is not compulsory, completing such a log will help learners extensively for learning aim D at the end of this unit.

- You will lead a discussion on project ideas. Four ideas have been provided in this document (see Delivery Guidance), although you are free to include ideas of your own (projects you may have previously used or projects that the learners themselves might suggest).

- Learners work in small groups to investigate the problem idea from three perspectives. Limiting the number of project ideas and allocating the projects used to more than one group will create an opportunity to compare the research carried out by the groups sharing the same project, thereby enabling learners to tweak their projects (if they missed anything key), although you should ask them to stay with their core idea.

## Learning aim B / Topic B2 – Feasibility study

- Do a presentation for learners to prepare them for carrying out the processes involved in a feasibility study. You will need to issue a feasibility study template that they will use to record their study, although they are only required to write notes under each section (not produce a full feasibility report).

- Learners carry out a feasibility study within their groups and recommend two possible solutions. If further support is needed, there are two links to content in the scheme of work to help them in this activity.

- You will need to look over the feasibility studies between the end of this session and the start of the next to ensure that learners are on the right track. There is no requirement for the interpretation of the project to be the same for all groups, but the study and recommendations should make sense before learners move on to project requirements.

## Learning aim B / Topic B3 – Project requirements

- Prepare a project requirements template and walk learners through the sections in the document. There are many online templates that you can adapt and use with your class. Once you have a suitable template, walk and talk learners through the document, explaining what it is and what should be included.

- Learners work in their groups to finalise the requirements using the document. The minimum content is defined in the scheme of work and learners should be instructed to include at least two visual elements from those listed in the spec (diagram, sketch, photograph, storyboard). The document will be completed in note form with supporting diagrams.

## Learning aim C / Topic C1 – Project phasing

- Prepare a PowerPoint presentation (although this could be a worksheet or other suitable product) and introduce learners to the concept of functional and non-functional requirements. Links for source materials have been provided in the scheme of work.

- You will need to prepare a list of project requirements for learners to use in the paired activity. A presentation/slide number has been provided which could be used to produce this list (and which essentially provides the answer for you).

- Working in their small groups, learners then create a functional versus non-functional requirements list based on the project requirements document they

created in the previous lesson.

## Learning aim C / Topic C2 – Typical project management processes

### Typical project management processes

- Understanding how to manage a project is formalised through the use of recognised project management processes. Learners work in pairs or small groups to investigate the project management processes. They should create a PowerPoint presentation targeted at a group of newly recruited project coordinators. Each pair or group should use the presentation slides to explain each of the processes. The final version should be presented to the class.

### Planning and monitoring project management processes

- Present the tools used to plan and monitor a project, demonstrating as many of them as possible from a practical perspective, or sharing documented examples with learners that you can walk through with them. What is a resource plan? What are the components? Why are time plans essential? What is a contingency and how can it be factored into a project? How are constraints identified and what happens if further constraints are uncovered during the project? How do you decide appropriate intervals for monitoring and control? Are they always the same intervals or should they vary?

- Learners should practise Gantt charting and critical path analysis using exercises and tutorials (see links in Resources section of this delivery guide).

- As practitioners, learners will have to become resourceful, creating online and paper-based information capture or recording documents to suit different situations. They may achieve this by simply using resources they find online – but it is more likely that they will need to analyse existing documentation and adapt it to make it more relevant to the situation. The activity requires learners to collaborate as a class to produce supporting documentation that they will ultimately all use as part of their assessed projects.

- Once completed, learners critique the products so that improvements can be made to produce final versions.

### Risk and issue processes

- Using videos and web content to stimulate discussion, you should discuss the whole concept of risk, risk severity and contingency with learners from a project and general business perspective. It will help to contextualise risk with personal examples. Links have been provided for you to use for this topic.

- It is useful if learners can investigate at least one project management tool in this area, such as the one listed in the scheme of work from www.mindtools.com. You can suggest a suitable alternative if one is available on your centre's systems.

- Learners should practise risk assessment by working with their small group on the scenario they have been using for practising the various components of a project. They should share their assessments with the class, who can sense check for any obvious omissions.

### Execution and management processes for a project

- Learners should carry out individual research (preferably using multiple sources) to develop a personal checklist of factors that they believe can influence the success of a project. The checklists should be discussed by the class to highlight similarities and omissions.

- Learners share their checklist with the class. The class then collaborate to identify the most important aspects of the checklist and then create a final version that should be uploaded onto a shared drive or the class social media page.

## Learning aim D / Topic D1 – Lessons learned from implementing an IT project

- You should now reissue the skills and behaviours audit completed by learners in the first session so that they can now revisit the document and make additional observations about where and how they feel they have improved.
- Learners should use the internet (or the centre's own learning centre resources if applicable) and identify sources such as videos or other materials that would help them to improve the skills they identified as needing improvement. A combined list of resources from all learners should be published and/or shared with the class.

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

Depending on the choice of project, the following units will provide useful underpinning knowledge and skills that can be drawn on to create the deliverables:

- Unit 1: Information Technology Systems
- Unit 2: Creating Systems to Manage Information
- Unit 3: Using Social Media in Business
- Unit 4: Programming
- Unit 6: Website Development
- Unit 7: Mobile Apps Development
- Unit 8: Computer Games Development
- Unit 11: Cyber Security and Incident Management
- Unit 13: Software Testing
- Unit 14: IT Service Delivery
- Unit 15: Customising and Integrating Applications
- Unit 16: Cloud Storage and Collaboration Tools
- Unit 19: The Internet of Things.

Further/complimentary study could include:

- Prince2®

## Resources

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

### Textbooks

- Hughes, B., 2012, *Project Management for IT-related Projects* (2nd edition). British Informatics Society Ltd, ISBN-13: 978-1780171180

  This book is available both as a Kindle edition and as a print book. As a BCS publication, it covers all aspects of project management in an IT context, including a significant proportion of the content of this unit.

- Mathis, B., 2014, *Prince2 for Beginners: Prince2 Study Guide for Certification and Project Management* (1st edition), CreateSpace Independent Publishing Platform, ISBN-13: 978-1501037115

  An inexpensive book that provides an overview of the working practices that underpin this methodology.

### Journals

There are a number of online project management journals that could be considered, but all involve a fee – for example:

- https://www.apm.org.uk/Project

  Project, the official journal of the Association for Project Management (APM).

### Videos

With the exception of the last video (which is generic and provides hints and tips for project managers), the videos below introduce project management concepts in relatively short, manageable parts that are ideal for setting as homework tasks.

- Agile project management tutorial: What is agile project management? (4 minutes)

  https://www.youtube.com/watch?v=MJR-EgHTA4E

- Prince2 project management explained - introduction (3 minutes)

  https://www.youtube.com/watch?v=YZyS90pl-N4

- Prince2 project management explained - principles (6.5 minutes)

  https://www.youtube.com/watch?v=wFPZNN-60qA

- Prince2 project management explained - themes (5 minutes)

  https://www.youtube.com/watch?v=P7EH-L2S4xk

- Prince2 project management explained - processes (5 minutes)

  https://www.youtube.com/watch?v=waj258ymT88

- Project management basics for beginners: 13 simple project management tips (5.5 minutes)

  https://www.youtube.com/watch?v=RT66tw1cKCA

**Websites**

- http://criticalpathmethod.weebly.com/solved-problem.html

  Critical Path Method – this site provides a problem with solution for learners to practise critical path analysis.

- http://infogoal.com/pmc/pmcart.htm

  Directory of Project Management Articles and White papers **–** a range of articles related to IT project management. This site contains links to other sites that have project management content such as BCS and ZDNet.

- http://vceit.com/p/gantt-pert-gantt-tute.htm

  Gantt Chart tutorial – a semi-practical exercise which presents a chart with questions and answers.

- https://www.mindtools.com/pages/main/newMN_PPM.htm

  Project Management: Delivering Complex Projects Successfully – a series of digital tools to support a range of business processes including project management.

- http://www.projectideasblog.com/2010/01/it-projects-for-students.html

  IT Projects for Students – a number of ideas for projects. Projects in blue can be clicked to show some demo systems to provide an element of inspiration. Projects in black have no demo option.

- https://www.theguardian.com/technology/2013/apr/21/fred-brooks-complex-software-projects

  Why big IT projects always go wrong – an interesting article that explores the challenges and potential pitfalls of undertaking large-scale IT projects.

*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.*

# Unit 10: Big Data and Business Analytics

## Delivery guidance

This internally assessed unit introduces learners to one of the most important concepts that have emerged in recent years. This is because data, big data and business analytics will only continue to present challenges (with more and more data added to systems every day) to organisations.

Although this is not a prerequisite as such, it would be most beneficial if learners had already studied Unit 2 (*Creating Systems to Manage Information*) before beginning this unit so that they were already familiar with terminology around data and data structures (as stored in databases etc). They should also have a good grasp of basic maths as they will be required to undertake statistical analysis. While you could argue that software exists that will do the calculations, learners must still understand what standard deviation, a central tendency or an interquartile range are.

Not only more and more data are being stored, the amount of data that need to be gathered and manipulated is growing. Databases (and data stores in general) are getting bigger and the ways in which they are being used are becoming increasingly diverse.

Data come in all shapes and sizes; they can be unstructured, structured or semi-structured, and it is now common to have data in volumes of multiple terabytes and more. Data can be drawn from an increasing range of sources:
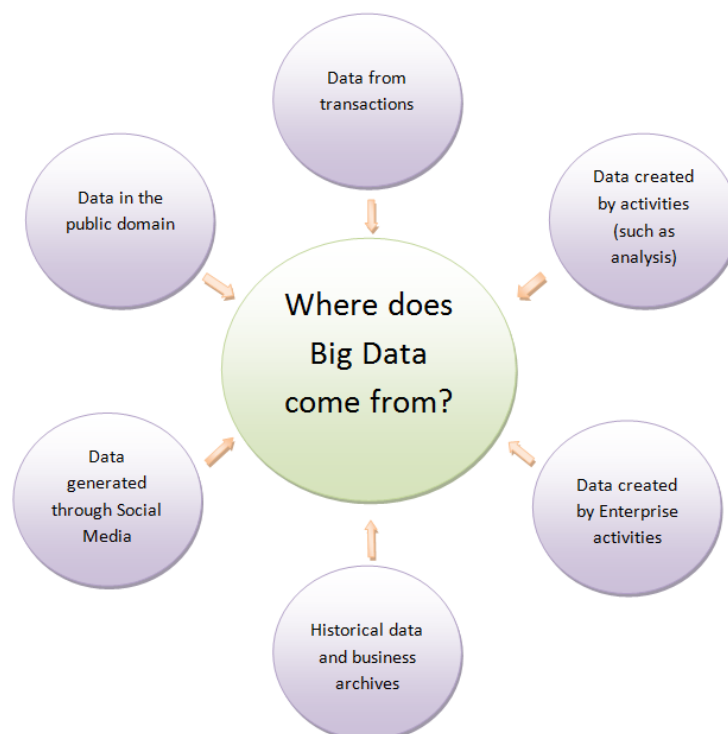


In delivering this unit the learners will explore the concept of data, including legislation related to their use, how they are stored, analysed (including how and why), and how data should be selected for analysis and presented to data users.

Learners will develop analytical skills, draw on other units for business contexts and ideas for analysis (e.g. to improve performance, in planning, to support decision making) and will learn a range of statistical techniques that support business activities.

As there are many different job roles that are reliant on good quality data, there is an opportunity here to involve a range of data users to talk to learners from an employer perspective (such as senior managers who set strategy, production and finance, and marketing managers who use data to make operational decisions).

## Approaching the unit

In order for analytical activities to have some meaning, you will need to acquire and prepare different data sets and provide access to industry software. Links to websites that offer data for analysis have been provided in the resources section of this delivery guide.

### Available data include:

- Business and economic data
- Crime and justice
- Defence
- Education
- Environment
- Government
- Government spending
- Health
- Mapping
- Society
- Towns and cities
- Transport
- FBI Crime Data (USA)
- CDC Cause of Death data (USA)
- Store data for Walmart (USA)
- Emails released after the collapse of Enron (USA).

### The approach to this unit should be:

- As practical as possible to give learners the best chance to apply a good range of analytical techniques.
- BTEC Level 3 IT/Computing qualifications have existed for approximately 30 years and it is likely that you will have an alumnus of previous learners who are now practitioners or managers in the sector. You may be able to persuade some of your alumni to provide the employer input. Alternatively you may have access to people who work with data, either internally or externally who could also bring real-life experience into the classroom.

## Delivering the learning aims

### Learning aim A
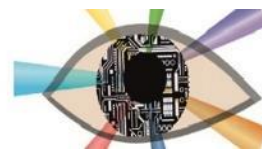
This aim sets the context for the unit by exploring from where data are gathered, how they are used and why they are important to different types of organisations.

Learners begin by exploring different business decision-making processes and how data contribute to this activity both strategically and operationally. Examples could include data used to explore customer behaviour (sales and marketing), data used to manage the structure of the business (finance and operations), data used to cost products or services (labour and materials) and data used for benchmarking to help organisations measure their success in relation to their competitors and their own previous performance.

The challenges of data such as the costs of gathering, storing and analysing them are considered. Learners will be introduced to a range of skills and techniques that they will need to master if they wish to work as analysts in this sector, and it is imperative that they understand the security and compliance requirements as applied to data.

Types of data are explored and data are categorised as internal or external with examples so that learners appreciate the diverse range of data sources. Whether internal or external, how data need to be gathered, cleansed, stored until needed and how this may happen (both in terms of the technology and the way the data are structured) is covered.

Understanding the role of data warehousing and the role of the more limited data mart will help learners to build a knowledge of likely data sources or places where data can be stored in the real world.

The aim completes with learners considering big data analysis including OLAP technology and the importance of checking any data used for validity, accuracy, sufficiency etc. They will investigate the four stages (or levels) of business analytics (descriptive, diagnostic, predictive and prescriptive analytics) and should be able to define these terms and the specific techniques that are characteristics of each stage.

**Learning aim B**

This aim focuses heavily on statistical techniques and the types of software that are available to analyse data sets. The software is not prescribed, which will allow you to choose a suitable or available product. A link has been provided in the resources that will enable you to choose free software from 50 choices that can be used at your centre and also by learners at home. Learners will have the challenge of using and navigating the software and some packages are much more difficult to master than others. Tutorialspoint (see the link in the resources section) provides a series of tutorials for some of the more common analytical tools. In addition to proprietary software, learners should explore the analysis capabilities of Microsoft Excel (or a similar spreadsheet software).

You will need to introduce learners to a range of statistics from the simpler measure of central tendency (mean, median and mode) to the more complex operations including standard deviation, range and dispersion.

Probability is a key decision-making tool and is a learning aim in its own right. You should ensure that learners can carry out routine and non-routine operations accurately. To ensure learners are able to do these calculations they should not only provide the answers, but should also be able to confidently show their working out and explain the processes.

They will explore the relationship between both independent and dependent variables using different techniques and should be able to work things out both with and without the use of software (so, e.g. using a calculator).

Learners will need to use at least one proprietary industry relevant software package in addition to Microsoft Excel to ensure they acquire a range of skills.

**Learning aim C**

This final learning aim will begin to teach learners the skills they will also need in the project – particularly in the investigation phase. At this level, learners should be able not only to select the right tools and techniques for particular situations, but also to justify their choices and actions – why did they choose one particular data set or another. At Level 4, learners will build on the learning from this unit and study how to integrate different data sets to provide a new set. Although there is no requirement to learn about this in this unit, learners may well question what they would do if a data set was incomplete. Data integration would provide one possible solution to the problem.

Wherever the data set comes from, learners should be able to show that they can select data and clean it (removing extraneous, inconsistent, inaccurate and incomplete data), format it consistently and, using appropriate software, produce outcomes from analysis that are relevant, valid and accurate.

## Assessment model (in internally assessed units)

| Learning aim | Key content areas | Recommended assessment approach |
|---|---|---|
| **A** Investigate the role of big data and business analytics to improve performance, for benchmarking and/or to trigger innovation in organisations | **A1** Business information<br><br>**A2** Types and storage of data<br><br>**A3** Analysing big data<br><br>**A4** Types of business analytics | A presentation focusing on how business analytics can be used by organisations to inform decisions that improve performance, for benchmarking and how this may result in innovation |
| **B** Explore the statistical software tools and techniques used to analyse data in organisations | **B1** Statistical techniques<br><br>**B2** Probability distributions<br><br>**B3** Mathematical modelling of data to find a goodness of fit | An informal report containing the results of learners' calculations and analysis of measured and supplied data, using appropriate software |
| **C** Carry out analysis of statistical data to meet the needs of an organisation | **C1** Selecting data for analysis<br><br>**C2** Evaluating a data set and presenting the outcomes | A formal report using software tools to analyse a data set for a given organisation and to present the outcome (visualisation) |

## Assessment guidance

The assessment for this internally assessed unit would benefit from being divided into three assignments as shown above.

### Assignment 1 (learning aim A)

A presentation that focuses on how analytics is used to inform business decisions. The presentation should explain the benefits and challenges that analytics brings to any business. You should provide a realistic scenario for learners to focus on their presentation, particularly as it will give them an opportunity to research and include some specific analytics that would be useful to such a client.

The scenario could be based on a business that has been asked to provide analytical services to a client and the learner has been asked to persuade a less than enthusiastic middle management team about how the information gained from the process could help them in their roles and in their everyday activity.

Learners should ensure that the presentation is suitable for the audience as defined in the scenario they are given.

As an idea, the tutor could prepare two or three different data sets/scenarios that would make watching the presentations more interesting and give learners an exposure to a wider range of situations.

You may choose to link this assessment to assignment 3, in which case the scenario should be drawn from the data set. The set will need to have at least 500 records to comply with the requirements for assignment 3.

### Assignment 2 (learning aim B)

This assignment suggests an informal report that requires learners to show their ability in carrying out a range of statistical calculations and applying analytical techniques. This includes carrying out t-tests on two sets of data. Executing operations and producing results that should be communicated appropriately, the learners should be able to evidence that they can logically structure an analysis, the results and demonstrate the use of the correct methods.

The scenario for this assignment will be drawn from the data set.

As all learners will essentially be producing the same answers, you might consider the addition of a viva to enable you to be confident about the skills and abilities of individual learners. This does not need to be extensive and cover all of the grading criteria/assignment content, but you might find this useful to support your decisions.

### Assignment 3 (learning aim C)

You have the option for this assignment to link the activity to the scenario (or scenarios) used in assignment 1.

The data should require cleaning and reformatting. You may therefore need to change formatting, make it inconsistent and add data that would need to be cleaned.

You should instruct learners to begin their formal report by restating the purpose of the analysis and the question that will be addressed.

For this assignment, learners will not need to produce their calculations, but should be able to explain (if asked) how they arrived at particular answers.

# Getting started

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

---

## Unit 10: Big Data and Business Analytics

### Introduction

Ask learners to share their own experiences of using data/information to make decisions.

Consider introducing the unit with the [documentary](#) listed in the resources section of this guide. It is a really interesting documentary that asks some fascinating questions that will make learners think about data in a number of ways.

### Learning aim A – Investigate the role of big data and business analytics to improve performance, for benchmarking and/or to trigger innovation in organisations

### Learning aim A1 – Business information

- Guest speaker presents to learners about how they use the results of data analysis in their everyday activity. This does not mean that you should invite a data analyst, and the speaker should be a data user. For example, a manufacturing manager who uses projected sales data to plan resource needs for the short and medium terms (raw materials, staff etc), or a sales or a marketing manager who needs to use demographic information to target a sales or a marketing campaign.

- Present the reasons why organisations analyse data (using the wider range of examples listed in the specification).

- Support a discussion on the general challenges of analysing data:

  o Why can gathering data be an expensive process?

  o What are the issues with data storage?

  o What are the main skills needed by staff who analyse data?

  o How important is maths? Learners may well say that as software exists they can do the calculations so maths may not be important – but you should counter that they should at least understand what a calculation means (in other words, the software may calculate the median – but what is a median? What is it for? What does it tell the analyst?).

  o What is the analyst's role in the security of the data that they use and interrogate?

  o What is the legal implication? In particular, you cite the Data Protection Act and the clause that says that data should only be stored for the purpose for which they are intended.

- Learners carry out group work (or paired work) to investigate legislative, ethical and security issues (in relation to both commercial and personal data). Split the class into three and then into pairs or small groups. Each group investigates one area. Learners create a slide presentation carousel to be used by a small business advisory service on its website to inform its members about the regulations (learners can add a narrative).

### Learning aim A2 – Types and storage of data

---

**Types of data:**

- Explain the difference between qualitative and quantitative data, and internal and external data. You should provide a series of examples that learners should categorise. For example,

  o Wages data are quantitative internal data.

  o Feedback from customer through a website about levels of service experienced will be external data, and if the responses are to open questions rather than answers with numeric values it will be qualitative.

  o Data from sensors in a greenhouse that is climatically controlled are internal and quantitative.

  o HR data about employees' sickness and holiday leaves which contribute to a calculation about the loss of production days which is internal and quantitative.

**Storing data:**

- When it comes to storing data there are a number of considerations. Learners work in pairs to find out what each of the following terms means:

  o structured data versus unstructured data

  o volume, velocity and variety

  o methods of ensuring data security (such as passwords and encryption)

  o data warehouse versus data mart (including variants of data marts such as confirmed, stand-alone).

  Learners should create either a crossword puzzle or dominoes game using their research (see links in the resources section). The other options (such as wordsearch maker) are not relevant for this level. The completed game should be tried/used by other learners in the class.

**Accessing data:**

- To complete this topic, present to learners on how data are shared across organisations, cite examples of software that is used by organisations to analyse the data and explain how data are managed to ensure only the right people have access to some or all of the data.

**Learning aim A3 – Analysing big data**

- Learners research and write a short report on the challenges of analysing big data (skills needed, software and technology available to analyse data, and the quality of the data themselves).

**Learning aim A4 – Types of business analytics**

**Four stages (or levels) of business analytics:**

- Learners work in pairs to create teaching materials that would explain the four stages to a group of learners. This gives learners an opportunity to explore the ways that they would like to be taught and to create resources that they would find interesting. Choice of resources created is at the discretion of learners.

**Learning aim B – Explore the statistical software tools and techniques used to analyse data in organisations**

**Learning aim B1 – Statistical techniques**

- You should ensure that you have acquired or prepared a series of worksheets that will allow learners to develop and practise their statistical skills across the range listed in the specification. There are two useful URLs in the resources section in this delivery guide that provide some prepared materials.

- Learners will need to spend time using a range of statistical techniques, practising the calculations and checking their answers against prepared answers.

### Learning aim B2 – Probability distributions

- Prepare (or acquire) a series of worksheets that will allow learners to develop and practise their statistical skills in probability as listed in the specification. There are two useful URLs in the resources section in this delivery guide that provide some prepared materials.

- Learners use software to carry out some of the calculations around distribution as shown in the unit content.

- Learners will need to spend time practising probability distributions and checking their answers against prepared answers.

### Learning aim B3 – Mathematical modelling of data to find a goodness of fit

- Prepare (or acquire) a series of worksheets that will allow learners to develop and practise their statistical skills in modelling and regression as listed in the specification. There are two useful URLs in the resources section in this delivery guide that provide some prepared materials. Learners should use spreadsheet functionality to support this activity.

- Learners will need to spend time practising mathematical modelling and checking their answers against prepared answers.

### Learning aim C – Carry out analysis of statistical data to meet the needs of an organisation

### Learning aim C1 – Selecting data for analysis

- Presentation that focuses on how data for analysis should be selected. This is best achieved by walking through a practical example (maybe using one of the data sets provided by the links in the resources section of this guide). For example, in the data.gov.uk data sets there is a spreadsheet of crime data, which includes hate crime and cybercrime. A link to this specific spreadsheet has been included in the resources section.

- Learners should practise data selection against defined criteria. For each activity you need to work through learners so that they should be able to explain their reasons for the approach taken.

### Learning aim C2 – Evaluating a dataset and presenting the outcomes

- In anticipation of the assignment, learners should cleanse and format a data set to prepare it for analysis. You may find it useful to manipulate a downloaded data set introducing formatting errors or adding errors (such as changing headings in a series of columns so that one obviously repeats (e.g. 2012, 2013, 2013, 2015 – where the second instance of 2013 should be 2014 – this error could be transitioned into the legends in a graph or a chart).

- Challenge learners by demonstrating poor examples of data presentation (such as pie charts with no legends or titles, graphs where the series have produce excessively small bars and lots of white space and spreadsheets with columns not suitably formatted to display all of the numbers in a cell). Ask learners what would need to be changed, added etc to improve the presentation.

- Learners analyse the data set cleansed in the first activity against defined criteria and prepare the reports that will communicate the outcomes to different audiences.

- In order to demonstrate that learners are able to adapt the presentation of outcomes to suit different audiences, you could ask learners to present the outcomes for two or three different audience types rather than repeating the process a number of times simply so that an understanding of this can be shown. The data being presented should be appropriately supported by text, images and narrative as appropriate to the context.

- Learners create a short presentation that explains how the outcomes of the analysis were valid, accurate and relevant.
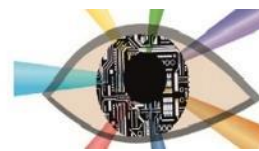
# Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Depending on the choice of project, the following units will provide useful underpinning knowledge and skills that can be drawn on to create the deliverables:

- Unit 1: Information Technology Systems
- Unit 2: Creating Systems to Manage Information
- Unit 11: Cyber Security and Incident Management
- Unit 15: Customising and Integrating Applications
- Unit 19: The Internet of Things
- Unit 20: Enterprise in IT

# Resources

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

## Textbooks

Marr B, *Big Data: Using SMART Big Data, Analytics and Metrics to Make Better Decisions and Improve Performance* (1st Edition), John Wiley & Sons Limited, 2015 ISBN 9781118965832 – This book is available both as a Kindle edition and as a print book. It is targeted at beginners investigating this subject for the first time, rather than for practitioners who may well need something more advanced.

Provost F, *Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking* (1st Edition), O'Reilly Media, 2013 ISBN 9781449361327 – Another good book that would suit a competent learner. It introduces analytical thinking and strategies for extracting knowledge from data to underpin business activity.

Winston WL, *Microsoft Excel 2013: Data Analysis and Business Modelling* (1st Edition), Microsoft Press, 2014 ISBN 9780735669130 – It helps learners to develop skills in using Excel to analyse and model data. This book is particularly good for predictive and prescriptive analysis.

## Journals

journalofbigdata.springeropen.com – This is a collection of published papers on a variety of data-related subjects.

http://www.journals.elsevier.com/big-data-research/ – Big data research journal – some samples and articles can be viewed.

http://www.kdnuggets.com/publications/journals-magazines.html – A series of journals, magazines in analytics, big data, data mining and knowledge discovery.

**Videos**

Choosing which statistical test to use – statistics help (9.5 minutes) (https://www.youtube.com/watch?v=rulIUAN0U3w)

Data Marts (1.5 minutes – no dialogue) (https://www.youtube.com/watch?v=q-ujADG0Nf8)

Data warehousing – An overview (9 minutes) (https://www.youtube.com/watch?v=zTs5zjSXnvs)

Big Data (53 minutes) – a range of videos introducing Big Data (https://www.youtube.com/results?search_query=Big+Data)

**Websites**

https://data.gov.uk/ – UK government statistical data (such as crime and justice data, business, educational, social and environmental data).

https://data.gov.uk/dataset/hate-crime-cyber-security – Hate crime and cybercrime data that could be used to demonstrate selection of data in learning aim C1.

http://www.kdnuggets.com/datasets/index.html – Publically available data sets in range of contexts.

http://mathsanswers.org.uk/stats/ – A series of printable notes and worksheets on a range of statistics (Edexcel A-level syllabus), but useful in this context.

http://www.predictiveanalyticstoday.com/top-free-statistical-software/ – This link provides details about, and access to, the top 50 free statistical software products.

http://www.resourceaholic.com/p/resource-library-statistics-level.html – A large resource bank for supporting the teaching of statistics. This includes teaching notes, questions and answer sheets.

https://www.springboard.com/blog/free-public-data-sets-data-science-project/ – Additional data sets including FBI Crime Data, CDC Cause of Death data, store data for Walmart and emails released after the collapse of Enron.

http://www.toolsforeducators.com/crossword/ – Educational games maker – this website is an online tool for creating a crossword puzzle. Learners carry out research and use the research to provide the answers, writing clues for each word included.

http://www.toolsforeducators.com/dominoes/ – Domino maker – this is a free online game maker for paper/card based dominoes. Learners supply the content (term and definition) and complete a series of dominoes that can be printed and played as an educational game.

https://www.tutorialspoint.com/big_data_tutorials.htm – This link has a series of tutorials for big data analytical tools.

*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.*

# Unit 11: Cyber Security and Incident Management

## Delivery guidance

As modern life becomes increasingly reliant on computer systems and the data they store, process and transmit, the battle to keep IT systems secure in the face of external threats, accidents and natural disasters becomes ever more challenging.

This mandatory externally assessed unit presents learners with the highly topical and challenging experience of studying cyber security threats and vulnerabilities, the methods used to protect systems and how to plan for, correctly investigate and manage potentially devastating security incidents.

Progressive cyber security and incident management relies on five core skills:

Knowing cyber security threats, system vulnerabilities and security protection

Understanding different networking architectures and how to secure them

Assessing the level of risk and the recovery methods available

Knowing how to collect evidence from a suspect system using forensically sound procedures

Cyber security and incident management

Designing comprehensive cyber security plans and creating detailed cyber security plans

This unit provides learners with a sound foundation in security and computer forensic disciplines for higher education.

It would be ideal if the class or course had a virtual learning environment, as this is a good way for learners to share some of their documented outcomes as recommended in this guide and in the scheme of work.

## Approaching the unit

Although this unit contains a considerable amount of theoretical content, the majority of the unit should be taught in an active fashion using targeted practical activities, particularly with regard to security and network-related concepts; therefore, this guidance recommends the use of pre-prepared disk images which contain the necessary resources or system 'snapshot', which will offer the advantage of reusability.

Where possible, all technologies used (hardware or software – see the Resources section for examples) should be open source projects or freeware. Case studies and reference material relating to current threats, vulnerabilities and protection methods should be as current as possible.

The use of regularly updated (and searchable) online databases and repositories are highly recommended.

Having quarantined network facilities and open source software available helps learners to simulate, detect, investigate and manage many different types of cyber security threats in a safe environment while providing a parallel to the real-world dangers they pose in a controlled and observable manner.

Newly discovered system vulnerabilities and devastating cyber security attacks frequently appear in news headlines, making it possible to collect and use examples as real-world case studies. This helps to ground and contextualise many of the concepts that the learners are studying, often making quite technically austere material come alive in exciting ways.

## Content area A: Cyber security threats, system vulnerabilities and security protection methods

This content area requires learners to demonstrate knowledge and understanding of technical language, security threats, system vulnerabilities, legal implications and security protection methods.

The investigation of different cyber security threats may be taught by exploring each type of threat and linking it to a real-world instance where the personal, financial, operational, reputational, legal or criminal impacts are very clear for the learner to see; this tends to reinforce the severity of each threat in learners' minds. Various approaches can be taken to help learners understand how external threats function, for example, there are many online videos which illustrate in a lively way how malware (malicious software) works or how to successfully hack a website or employ social-engineering techniques. Other possibilities include asking socially active ethical hackers or system administrators if they would be willing to act as guest speakers.

System vulnerabilities are best tackled by exploring each category (network, organisational, software, operating system, etc.) and selecting particular exploits that can be replicated, in particular replicated by each learner. Practical examples could include deliberately infecting a target machine on a quarantine network with an infected download, performing an SQL injection on a locally hosted web application or accessing administrative web interfaces on Internet of Things (IoT) devices such as webcams via default passwords. Learners can also be encouraged to explore up-to-date sources of information for known hardware and software vulnerabilities to exploit, though this would require suitable supervision. More traditional forms of vulnerability, i.e. theft of portable hardware, can be best demonstrated by leveraging appropriate physical security measures designed to prevent this, such as security locks, CCTV and protected cabling.

The specific UK legislation thematically linked to this unit may be covered elsewhere, but traditionally, it is best taught through research and presentation.

Other techniques such as court-based role play using case studies may offer a viable and more active approach.

Complete this content area by revisiting the threats and vulnerabilities identified earlier and demonstrating the software and hardware measures that can provide protection against them. Once again, this is best delivered by means of demonstration and a round robin of practical activities which learners can try individually, in pairs or small groups. Good examples include encryption and decryption of data, disinfecting malware from computer systems, installing and configuring firewalls to block bad network traffic, improving user authentication, changing user permissions, enabling MAC filtering and wireless encryption, and hardening server-side scripts to filter SQL injections. This technique allows learners to associate each potential threat with a practical solution; this preparation will be beneficial for Part A of their externally set task.

## Content area B: Use of networking architectures and principles for security

This content area requires learners to have a working knowledge of different networking architectures, different services and their functions and how to secure them in organisational contexts.

Networks are the core target of many cyber security threats, with their continued operation and robustness against internal and external threats playing a key role in the practicability of an organisation's day-to-day operations.

You should essentially split this content area into three parts, focusing on the network types, the network components that are used and the typical resources and services that the network provides.

Networking topics such as types (LANs, WANs, SANs, etc.) and their physical and logical topologies and adherent standards (i.e. 802 family, etc.) are well documented, with a wealth of reference texts, video tutorials and websites available for learner use (see Resources section for examples). Directed research is often the best way to teach this aspect but there are alternatives, such as investigating a 'volunteer' network infrastructure to discern its type, topologies and standards, perhaps as part of an organised industrial visit.

The coverage of network components is most effectively taught in a practical manner, combining as many hands-on network building activities as possible, including the use of as many different types of end-user devices, connectivity devices and media types as possible. The assembly of a small quarantine network is ideal, as it can then be used as a platform for the installation and use of network applications, components and resources. Where physical kit and space is limited, the use of virtual network design and visualisation tools such as Cisco Packet Tracer is highly recommended.

Explore network infrastructure and services by pairing presentation and demonstration, supplemented by online videos and animations that detail their working (see Resources section). Clearly, the use of a quarantine network would enable learners to set up a DNS server, configure a DHCP service and populate typical directory services (DS) in a very active way. It may seem obvious, but not only is it rewarding for the learner to both configure the DHCP address pool on a server and change a networked client to obtaining its IP address from a dynamic DCHP request rather than using a static address, but it also makes the process exceptionally transparent and easy to understand. Try to demystify many such services and resources this way, including shared services (files and printers), web hosting and internal email. Again, where practical limits are felt in the classroom, many network visualisation tools, such as the Cisco Network Simulator, support simulated services, offering you a viable alternative – although there are open source simulators available, such as Cloonix and Mininet.

It should be noted that many networking concepts involve the use of different number bases including (but not limited to) binary, octal and hexadecimal, so there are several opportunities to reinforce numeracy in this topic. It is also a good idea to link security concepts to network infrastructure and services, e.g. when demonstrating or configuring DHCP on a wireless network, stress that the assignment of an IP address could be reliant on the client device's MAC address being successfully filtered. This helps the learner to forge links between the two topics and is great preparation for Part A of the externally set task, which requires practical security solutions.

## Content area C: Cyber security protection plan

This content area requires learners to assess risk vulnerabilities and the levels of risk attached to those vulnerabilities, evaluate protection methods and develop security plans which make reasoned judgements and draw conclusions about their efficacy.

Broadly speaking, we can separate this content area into three parts: assessing computer vulnerabilities, assessing the risk severity for each threat identified and creating a cyber security plan for a given system.

In order to assess a computer system's vulnerabilities, it is vital that learners have access to quarantined systems that they can interrogate as well as a range of software tools for which they need to be given formal instruction and time to become proficient. Activities such as port scanning a test server are easily accomplished and there are several command line and GUI-based utilities that can perform this task. Where possible, command-line tools should be preferred, as this will reinforce learners' reliance on Microsoft Windows and GUI-based utilities. The Open Web Application Security Project (OWASP) Top 10 (currently being collated for 2016) provides a good reference list of popular exploits of which learners should be made aware, perhaps studying some of these as selected case studies.

The perennial popularity of web application vulnerabilities (particularly poorly-written PHP, among others) suggests that the use of deliberately vulnerable applications makes an instructive test bed for learners to explore the impact and risks of poor programming. This type of activity can be particularly illustrative as it is possible for learners to exploit the application 'as is' from a web client, then amend the application's source code on the server using OWASP recommendations and finally try to exploit (usually unsuccessfully) from the client once more. Performing these 'real world' vulnerability fixes is good preparation for the type of thinking required when creating a cyber security protection plan.

For any identified threat, it is necessary for learners to calculate its risk severity using the recommended matrix (see unit content), which balances threat probability with impact level/value of the loss incurred. The best way to cover this process is to work through a set of threats and let learners decide, by applying the risk severity matrix, how urgently an appropriate protection measure show be selected and applied. Moderated group discussion, perhaps collating findings from smaller working parties, each with their own identified threat to rate, is often a good technique to employ here.

Asking learners to produce a cyber security plan for a system without first having seen a model paper is difficult. As such, although it is possible to present a checklist of content that would be expected in such a plan, e.g. software and hardware protection measures, risk assessment, constraints, legal responsibilities, etc., it is far more revealing to lead the reverse-engineering of an existing document and ask learners to identify its different features. From here, it should be possible to ask learners to construct a document for a selected case study (after they have investigated, identified the vulnerabilities and

assessed their risks) and realistically expect them to include similar content in the anticipated format.

## Content area D: Cyber security documentation

This penultimate content area requires learners to be able to understand governance policies and documents needed to establish and maintain security on an ongoing basis.

You will need to present a number of different policies including ISO 270001:2013, typical organisation policies and policies that enforce relevant legislation, e.g. the Data Protection Act (DPA).

Governance policies, international standards and organisation-level policies can feel very remote if they are not grounded within the learners' everyday experience of IT systems and processes. Linking IT policies to the required complexity of their user passwords is perhaps one way to forge a connection. Backup of learner data and acceptable use of email and the internet may also provide easy rationales for IT policies. The challenge here is to ask learners to metaphorically 'cross the floor', thinking more like a technician trying to secure a system than an actual user who may resent the limitations the policies place on their user experience.

In addition, various forms of relevant legislation appear in many other units on the programme, so integration across subjects, e.g. data protection themes, is an entirely viable learning tactic.

Other areas of focus should include incident response and disaster recovery policy. The content list in the specification is very thorough and is best delivered through small case studies, role-play activities (e.g. how to report an incident correctly) and key documents for review and discussion. Group discussion is a useful technique for debating the pros and cons of a particular response to a given incident.

Finally, you will need to introduce the role of the external service provider (ESP). You may be able to find local companies who fulfil ESP roles (e.g. hosting and data warehousing) to discuss (in general terms) the types of agreements that they establish with their clients. Moderating a prepared question-and-answer session on these agreements should identify any gaps in coverage that need to be addressed, e.g. particularly with regard to dispute resolution, etc.

## Content area E: Forensic procedures

This final content area requires learners to analyse forensic evidence data and information to identify security breaches and manage security incidents.

Forensic computing principles rely on process and strict recordkeeping, particularly with regard to keeping a chain of evidence. As such, the key to delivering this part of the unit's content is to focus on the professional characteristics that this type of task demands – thoughtfulness, diligence and good organisation.

Use a popular Linux distribution to teach a number of new practical skills, e.g. cloning a file system, checking recently mounted devices, showing recent firewall activity, viewing configuration files and scanning a system for operating security holes, network or application vulnerabilities. Many open source and freeware forensic tools for Linux-based operating systems can be downloaded from several reputable websites that enable these types of activity. Guest speakers, perhaps from the institution's own network infrastructure and services team, may be willing to provide additional insight.

At every stage, it should be made clear to learners that they must observe the challenges of live forensics – the need to work in situ, the ability to recover

deleted files or read encrypted ones, dumping the contents of live RAM to disk – all while avoiding the loss of temporary files that may contain vital information.

The use of a live case study, conducted with model procedures, is perhaps the best way to deliver this content area, allowing learners to investigate a realistic scenario and gather their evidence using recommended tools and techniques in a controlled environment. Learners should ideally work in pairs or small groups as this can stimulate lively discussion and rationalisation of their findings in order to make appropriate judgements and recommendations. The case study may take the form of a hacked server with deliberate footprints of the intruder's actions logged and discoverable; the presence of suspect files, recently deleted files, doctored log files, amended databases or configuration changes are easy to manufacture. Removing existing protections or the deliberate creation of 'flawed' security settings are also obvious 'clues' that can be engineered.

Learners should initially be equipped with a good range of tools and techniques that make it possible to investigate, find and – most importantly – record the evidence they need without damaging or changing it. Note that learners will be required to complete a forensic incident analysis based on unseen evidence as part of their external assessment. Appropriate recording tools (electronic or paper-based) should be made available, along with examples of similar cyber security documentation (policies and procedures) that they can use to recommend revised security protection measures based on the evaluation of their forensic findings.

## Assessment guidance

As an externally assessed unit, Pearson will provide a set task which must be completed under supervised conditions, contributing to 42% of the total qualification guided learning hours (GLH).

Learners are expected to complete this set task over a period of nine hours, split over a number of sessions occurring in a three-week period timetabled by Pearson. The task has two separate parts – Part A, taking five hours, and Part B, using the remaining four hours of the allotted time.

Both tasks should be completed in strict order using a computer and submitted electronically. There are 80 marks allocated for this task and it will be marked using a level-based mark scheme that is located in the programme's online Sample Assessment Materials.

Pearson will provide sample materials that you may use to help learners prepare for assessment. The availability of the task is December/January and May/June each year. The first assessment availability is May/June 2018.

Across Parts A and B, students will be expected to complete the following activities based on a realistic scenario:

- Risk assessment of the networked system

- Develop a cyber security plan for the networked system

- Write a management report with a solution justification – PDF document

- Prepare a forensic incident analysis based on realistic evidence (unseen)

- Write a management report detailing improvements in a given system.

See the SAMs for full details.

You can help to fully prepare learners by creating micro-tasks which duplicate elements of the task provided through Pearson's sample materials, working through these with learners in an interactive and mentoring fashion. Draw out learners' technical understanding, assumptions and exactly how they are

interpreting the task; many marks are often lost due to misinterpretation and misunderstanding.

Students planning will need to include the following information:

1) Threat(s) addressed by the protection measure

2) Details of action(s) to be taken

3) Reasons for the actions

4) Overview of constraints – technical and financial

5) Overview of legal responsibilities

6) Overview of usability of the system

7) Outline cost-benefit

Analysis of the sample mark scheme will help learners to discover the level of thought processes, problem-solving and scope that their answers must provide at this level, making the division between pass and distinction grade descriptors much more transparent.

Above all, advise learners that the appropriate use of technical language needs to be consistently high throughout both parts of the set task to achieve higher grades.

# Getting started

**This provides you with a starting point for one way of delivering the unit, based around the recommended assessment approach in the specification.**

| Unit 11: Cyber Security and Incident Management |
| --- |

## Introduction

Introduce this unit by ascertaining the learners' experience with security issues and vulnerabilities; many may have experienced having their access to products and services denied due to system outages caused by cyberattacks or internal failures. The tutor can reference current events such as recent high-profile attacks (2016) including Tesco Bank, Talk Talk or Sony PlayStation.

A secondary thread to follow that cements the importance of the unit is to ask how many day-to-day activities involve the use of computers, particularly those that store, process and communicate valuable, private or critical data. Combining this with tell-tale statistics such as the excessive number of probes and hacking attempts a typical website receives each day will hopefully reveal the scale of the problem that IT security professionals face.

Where possible, most aspects of this unit should be taught in a practical manner; although there is certainly a considerable amount of theoretical knowledge for the learners to engage with, particularly in terms of correct business processes and legislation, the key to securing a computer system (or forensically investigating one) is being able to select and use the necessary tools and techniques appropriately.

You may also consider appointing (or asking for volunteer) learners with more networking or operating system experience, particularly with Linux distributions, to act as classroom support.

## Content area A / Topic A1 – Cyber security threats

You will detail different types of cyber security threats.

- Differentiate between internal and external threats.
- Lead a presentation, complete with sample case studies and examples, that shows how internal threats occur, e.g. sabotage, theft, natural disasters (flood, etc.), unauthorised access, system vulnerabilities and unsafe practices, etc.
- Lead a presentation, complete with sample case studies and examples, that shows how external threats occur, e.g. malicious software (different types), hacking (individual, commercial and government sponsored), sabotage and social engineering.
- Follow up with group discussion incorporating learners' own experiences, e.g. leaked passwords, compromised accounts, Sony emails and account hack, Xbox Live DoS attacks, etc.
- Ask learners to investigate selected case studies which focus on the impact (operational, financial, reputational or intellectual loss) of a threat or vulnerability which has been exploited. This can be used later for identification in risk assessments.
- Ask learners to cloudburst how organisations can keep abreast of the changing landscape of cyber security threats and protect their operations and data.
- A template for the cyber security plan can be found on the Pearson website – it is highly recommended that this is used as it ensures complete coverage of the requirements.

## Content area A / Topic A2 – System vulnerabilities

You will detail different types of system vulnerabilities.

- Lead a presentation, with supporting practical demonstrations, of different types of system vulnerabilities, for example, a badly configured firewall, poorly selected file permissions or user privileges, weak password policy, etc.

- Demonstrate the dangers posed by software applications. This could be achieved by downloading an infected application from an untrusted source onto a quarantined PC and observing the impact, performing an SQL injection attack on an insecure web application, etc.

- Discuss topical references, e.g. botnets utilising weak security on IoT (Internet of Things) household devices to perform DDoS (Distributed Denial of Service) attacks.

- Ask learners to research software and hardware vulnerabilities for specific products using appropriate sources, e.g. CVE database. Note: it may be practical to duplicate well-chosen examples in a controlled network environment.

- Ask learners to create informational posters which demonstrate common attack vectors, including Wi-Fi, Bluetooth, etc.

## Content area A / Topic A3 – Legal responsibilities

You will detail the relevant UK and EU (European Union) legislation that applies to different systems.

- Ask learners to summarise relevant UK and EU legislation, presenting their findings to their peers. A blog, wiki or podcast could be suitable vehicles.

- Lead a discussion that links the different legislation available to how an organisation (and individuals) should respond.

- Compare and contrast with similar legislation available internationally, e.g. 2001 USA Patriot Act, 1998 Digital Millennium Copyright Act (DMCA), etc.

- Explore news stories and case studies that incorporate prosecutions under UK and EU legislation. Encourage learners to consider the impact of internet-based cybercrime on the sovereignty of legal authority.

## Content area A / Topic A4 – Physical security measures

You will discuss and demonstrate various physical security measures.

- Learners will be familiar with many common physical security measures such as locks, protected cabling, card entry and closed-circuit television (CCTV). As such, place more emphasis on the physical security measures used to secure specific locations such as hosting companies and data warehouses. Opportunities may exist to send small parties of learners on industrial visits to this type of location by arrangement.

- Demonstrate use of biometric devices to access systems, e.g. unlocking a desktop PC using a fingerprint scanner.

- Discuss physical security measures as applied to data storage, data protection and backup procedures.

## Content area A / Topic A5 – Software and hardware security measures

You will explore various software and hardware security measures with learners.

- Lead, demonstrate and support round-robin practical activities which:
  o task learners with installing various types of anti-virus software, updating their signatures and selecting appropriate actions to disinfect affected files.
  o task learners with installing and configuring a firewall to accept, block, drop or log specific packets of data depending on various aspects of the transmission, e.g. connection state, source or destination IP, UDP or TCP, port number, etc.
  o task learners with testing various login procedures, particularly those with multi-factor authentication. Learners should experiment with creating strong

passwords and different forms of authentication, including knowledge-based, Kerberos and certificate-based (e.g. SSH public/private key pairs and agent forwarding).

- o allow learners to change authorisation and user permissions to affect their (and others') access to resources, e.g. folders, files, processes and physical devices.

- Discuss the concept of trusted computing and its key components, e.g. endorsement key, memory curtaining, sealed storage, etc.

- Present basic encryption concepts including how it works (an outline), its objectives and commercial applications. Make sure each commercial example has a realistic real-world demonstration, e.g. using an HTTPS connection on a website to obscure the transmission of sensitive data such as usernames and passwords on a login.

- Demonstrate how to secure a wireless local area network (WLAN) from unauthorised access using techniques such as channel changing, MAC address filtering, limited guest networks, SSID broadcast suppression, wireless encryption (WEP, WPA, WPA2, WPS), etc. Note: there are many tutorials on popular video sharing sites that demonstrate the successful reveal of WEP encryption keys. This type of activity can usually be replicated very cheaply (using older hardware and open source software) in a controlled classroom environment. These techniques can be used as an aid in the development of risk assessments.

## Content area B / Topic B1 – Network types

You will introduce the concept of different network types, their topologies, components, services and resources.

- Present the applications and features of networks. Networks can be introduced in ascending order (e.g. PAN to WAN) and terms like intranet, extranet, internet and cloud should be fully defined and differentiated.

- Discuss physical and logical topologies and ask learners to explore different types; asking learners to create network topology posters can be instructive as they are visual in nature.

- Using appropriate media, connections and devices, demonstrate the various standards for wired and wireless connections.

- Differentiate between different network architecture models, including peer to peer, client/server and thin client.

- Using an example, discuss and highlight modern trends in networking including 'bring your own device' (BYOD), the 'Internet of Things' (IoT) and software-defined networking (SDN).

- Introduce network visualisation tools that enable learners to create networks and interpret schematic diagrams in an interactive fashion; Cisco Packet Tracer is a good example of this type of application.

## Content area B / Topic B2 – Network components

You will demonstrate the different components of a network.

- Allow learners to examine and combine different types of network component with the aim of creating a simple Local Area Network (LAN).

- Introduce applications and features of external media and storage, including flash drives and optical media.

- Demonstrate the different applications and features of a variety of software components. Activities for learners could include:
  - o installing and configuring a network operating system.
  - o using network tools to confirm connectivity or troubleshooting issues.
  - o using monitoring tools to view network throughput.
  - o viewing network events and system/device logs.

- o   sniffing transmitted packets in network traffic using a protocol analyser.
- o   scanning a network's open ports for vulnerabilities.
- o   installing and testing network-aware applications such as relational databases by remotely connecting and querying a simple data source.

## Content area B / Topic B3 – Networking infrastructure services and resources

You will detail networking infrastructure services and resources.

- Explain the application and function of Transmission Control Protocol/Internet Protocol (TCP/IP), ports, packets and network address translation (NAT), including the structure of IPv4 and IPv6 addressing and RFC 1918 private addresses. Use of a protocol analyser to capture incoming and outgoing data packets can be very informative when tracking a simple network operation such as a ping. Learners are able to use such tools to track packets 'in' and 'out' of their computer, inspecting the data being sent and the source and destination IP addresses.

- Ask learners to investigate network configuration, including the use of domains and sub-domains.

- Demonstrate different configurations that change the way network devices work, e.g. a router issuing IP addresses via DHCP. Another good example would be using a switch to segment a network using its Virtual Local Area Network (VLAN) functionality.

- Help learners to explore a variety of network infrastructure services such as domain name system (DNS), directory services (DS), including Microsoft Windows Active Directory and open source implements such as OpenLDAP, Dynamic Host Configuration Protocol (DHCP), routing and remote access services such as Remote Desktop Protocol (RDP) or Secure Shell (SSH).

- Demonstrate the installation, configuration and use of network services and resources including file and print services, web hosting, mail and communication services. A good example is to enable a web server on a quarantine LAN and access its resources via a client using HTTP requests. The whole HTTP request and response process can be tracked by viewing these requests using a protocol analyser, inspecting the web server's access log, and finally rendering the transmitted resource on a web browser. Demonstrate real-time modifications to the served content by requesting the resource again.

## Content area C / Topic C1 – Assessment of computer system vulnerabilities  and C2 Assessment of the risk severity for each threat

- Demonstrate how to calculate the risk severity for each threat.
- Define the risk severity as being the probability of the threat occurring multiplied by the expected impact level/value of the loss.
- Differentiate risks as being low, medium, high and extreme. This can link back to earlier topics where risks and exploits were identified.
- Differentiate the probability of the threat occurring as being unlikely, likely and very likely.
- Differentiate the impact level/value of the loss as being minor, moderate or major.
- Ask learners to create a risk severity matrix (opportunities exist here for manual diagrams, word-processed tables, spreadsheets, website forms or programmed solutions).
- Using a given set of real-world scenarios, ask learners to assess the probability and impact levels and thus calculate the risk severity. Discuss findings with learners.
- Review risk assessment approach and methods.

## Content area C / Topic C3 – A cyber security plan for a system

Create a cyber security plan for a system.

- Discuss when to plan cyber security measures (based on medium, high and extreme risk severity for identified threats).
- Present a model cyber security plan for a given scenario and walk learners through the various sections, e.g. software and hardware protection measures, risk assessment, constraints, legal responsibilities, etc.
- After separating learners into groups of three or four, ask them to construct a document for a selected case study (after they have investigated, identified the vulnerabilities and assessed their risks) with realistic expectations of them including similar content in the anticipated format. Note that learners will need to cover the following areas in their assessment:

  1) Threat(s) addressed by the protection measure

  2) Details of action(s) to be taken

  3) Reasons for the actions

  4) Overview of constraints – technical and financial

  5) Overview of legal responsibilities

  6) Overview of usability of the system

  7) Outline cost-benefit

- Ask learner groups to swap their plans with their peers and task them with evaluating whether the protection measures would work as intended, identifying any good practice and possible areas for improvement.

## Content area D / Topic D1 – Internal policies

Detail the cyber security documentation which needs to be observed, established and maintained by an organisation.

- Present general IT policies, their content and rationale.
- Discuss and explore incident response policy.
- Discuss and explore disaster response policy.

## Content area D / Topic D2 – External service providers

Explore the role of an External Service Provider (ESP).

- Discuss ESP agreements for cloud services, applications and storage.
- Discuss ESP agreements for hardware and software.
- Present the implications of ESP agreements.
- Ask learners to determine which types of agreements may be covered by data protection laws.

## Content area E / Topic E1 – Forensic collection of evidence

Detail the process of collecting evidence using a forensically sound methodology after a security incident.

- Present desktop forensic activities.
- Lead and support practical sessions that impart new practical skills, e.g.:
  o cloning a file system
  o checking recently mounted devices
  o showing recent firewall activity
  o viewing configuration files
  o scanning a system for operating security holes and network or application

vulnerabilities.

- Ask guest speakers, perhaps from the institution's own network infrastructure and services team, to provide additional insight and hold a learner question-and-answer session.
- Discuss the challenges of live forensics with learners.
- Examine the procedures required to perform network forensics.

## Content area E / Topic E2 – Systematic forensic analysis of a suspect system

Detail the systematic forensic analysis of a suspect system.

- Discuss the requirements for maintaining accurate records.
- Present a checklist of different evidence sources and demonstrate how to attain them.
- Work through a model forensic report of an incident and ask learners to evaluate the findings and determine whether or not they prove a crime has been committed, show the source of the compromise (internal or external) and ascertain whether or not a single cause can be clearly proven.
- Ask learners to make recommendations on how to prevent similar security incidents from reoccurring in the future in the form of a report. Learners should draw on security measures that they have already been taught, but they must justify their selections appropriately.
- Provide learners with feedback on their recommendations.

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

- Unit 1: Information Technology Systems
- Unit 2: Creating Systems to Manage Information
- Unit 3: Using Social Media in Business
- Unit 4: Programming
- Unit 6: Website Development
- Unit 7: Mobile Apps Development
- Unit 8: Computer Games Development
- Unit 9: IT Project Management
- Unit 12: IT Technical Support and Management
- Unit 13: Software Testing
- Unit 14: IT Service Delivery
- Unit 15: Customising and Integrating Applications
- Unit 16: Cloud Storage and Collaboration Tools
- Unit 19: The Internet of Things
- Unit 21: Business Process Modelling Tools

Further/complimentary study could include:

Vendor-specific qualifications, e.g.

Cisco Entry and Cisco Associate

http://www.cisco.com/c/en/us/training-events/training-certifications/certifications.html
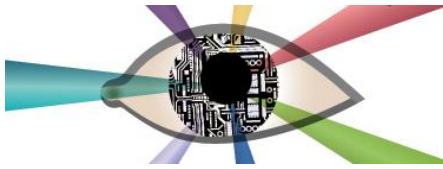
Vendor-neutral qualifications, e.g.

CompTIA Network+

https://certification.comptia.org/certifications/network

CompTIA Security+
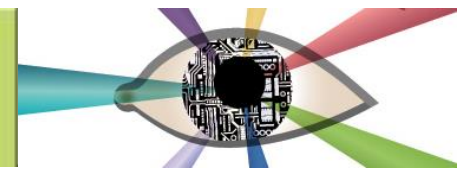
https://certification.comptia.org/certifications/security

## Resources

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

## Textbooks

- Clarke, Justin, 2012, *SQL Injection Attacks and Defense*. Elsevier. ISBN-10: 1597499633, ISBN-13: 978-1597499637

  Understanding SQL injection, one of the most well-known security vulnerabilities on the internet.

- Clark, Ben, 2013, *Rtfm: Red Team Field Manual.* CreateSpace Independent Publishing Platform; ISBN-10: 1494295504 ISBN-13: 978-1494295509

  RTFM contains the basic syntax for commonly used Linux and Windows command line tools.

- Lowe, Doug, 2016, *Networking All-In-One For Dummies*. John Wiley & Sons, sixth revised edition; ISBN-10: 1119154723, ISBN-13: 978-1119154723

  Details network planning, administration, protocol, virtualisation, cloud networking, servers, etc.

- Mandia, Kevin et el, 2014, *Incident Response & Computer Forensics*. McGraw-Hill Education, third edition. ISBN-10: 0071798684, ISBN-13: 978-0071798686

  Covers the entire lifecycle of incident response, including preparation, data collection, data analysis and remediation.

- Meeuwisse, Raef, 2015, *Cybersecurity for Beginners*. Lulu Publishing Services, ISBN-10: 1483431231, ISBN-13: 978-1483431239

  Overview and discussion on the essentials of cybersecurity, including a number of case studies and a good glossary of terms.

- Nikkel, Bruce, 2016, *Practical Forensic Imaging: Securing Digital Evidence with Linux Tools.* No Starch Press, ISBN-10: 1593277938, ISBN-13: 978-1593277932

  A text that shows how to secure and manage digital evidence using Linux-based command line tools, many of which are open source.

- Sammons, John, 2015, *The Basics of Digital Forensics*. Elsevier, second edition, ISBN-10: 0128016353, ISBN-13: 978-0128016350

  An introduction to computer forensics, covering a range of devices, key concepts and the tools needed to perform examinations. This text also includes guidance on how to collect evidence, document the scene and recover deleted data.

## Journals

- Cyber Defense Magazine

  http://www.cyberdefensemagazine.com/magazine/

  A magazine dedicated to IT security

- Digital Forensics Magazine

  https://digitalforensicsmagazine.com/
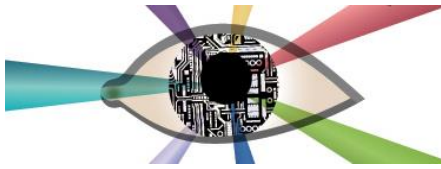
A magazine that investigates the digital world

- SC Magazine UK

  https://www.scmagazineuk.com/

  A cyber security magazine with cyber-crime and business news

## Videos

- Hack All The Things: 20 Devices in 45 Minutes

  https://www.youtube.com/watch?v=h5PRvBpLuJs

  A lecture revealing 20 device vulnerabilities and how they can be exploited.

- SQL Injection Basics Demonstration

  https://www.youtube.com/watch?v=h-9rHTLHJTY

  A demonstration of using SQL injection techniques to exploit a web application.

- Vulnerability Assessment and Mitigating Attacks

  https://www.youtube.com/watch?v=tiCCi8pX270

  A simple overview of these concepts.

- Computer Forensic Tutorials

  https://www.youtube.com/playlist?list=PL6oHuo5it4TgA-ZtIo3x5G0l0HDwPPZ9d

  A series of computer forensic tutorials from O'Reilly with videos that cover capturing traffic, volatile information, checkpoints, Unix tools, forensic toolkits, etc.

- Network Threats: Port Scanning

  https://www.youtube.com/watch?v=N5sKVaQLYjY

  Part of a larger series on network threats, this instalment focuses on port scanning (for both validation of security policy and vulnerability reconnaissance).

- NETWORK TYPES: LAN, WAN, MAN, WLAN, PAN, SAN

  https://www.youtube.com/watch?v=7RBddlGeyqY

- A complete overview of the different types of network. Automatic IP Address Assignment: How DHCP Works

  https://www.youtube.com/watch?v=RUZohsAxPxQ

  Explains the concept of DHCP, an application-layer protocol that your own computer probably uses to get an IP address from your network.

## Websites

- Acunetix Vulnerability Scanner

  http://www.acunetix.com/vulnerability-scanner/

  Automated tool which crawls a website looking for common vulnerabilities.

- Cisco Packet Tracer

  https://www.netacad.com/about-networking-academy/packet-tracer/

  Free network simulation and visualisation tool.

- Cloonix

  http://clownix.net
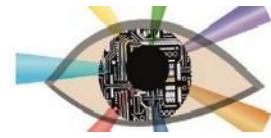
Open access network simulator

- Common Vulnerabilities and Exposures (CVE)

  https://cve.mitre.org

  An online dictionary of common names for publicly known information security vulnerabilities.

- Mininet

  http://www.mininet.org

  Open Source Network Simulator

- The National Vulnerability Database (NVD)

  https://nvd.nist.gov/

  The NVD is updated whenever a new vulnerability is added to the CVE dictionary of vulnerabilities. The vulnerabilities are then analysed by NVD analysts and augmented with vulnerability attributes.

- Forensic Control

  https://forensiccontrol.com/resources/beginners-guide-computer-forensics/

  Introduction to computer forensics

- How Domain Name Servers Work

  http://computer.howstuffworks.com/dns.htm

  Overview of DNS by howstuffworks.com.

- OpenLDAP

  http://www.openldap.org/

  OpenLDAP Software is an open source implementation of the Lightweight Directory Access Protocol.

- Open Web Application Security Project (OWASP)

  https://www.owasp.org/index.php/Main_Page

  Worldwide not-for-profit charitable organisation focused on improving the security of software.

- Penetration testing practice lab – vulnerable apps / systems

  https://www.amanhardikar.com/mindmaps/Practice.html

  A portal of links to vulnerable web applications, operating system installations, etc.

- Wireshark

  https://www.wireshark.org/

  Wireshark is, according to its publisher, the world's foremost and most widely used network protocol analyser.

*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.*

# Unit 12: IT Technical Support and Management

## Delivery guidance

As computers increasingly become the most critical aspect of any modern business system, the need for comprehensive and responsive IT technical support and management continues to grow, often outstripping available demand. Consequently, as it offers one of the most approachable routes into the IT sector through further and higher education, the role of the IT support technician is an obvious path from which many learners successfully start their career.

In addition to having a first-class understanding of the hardware and software that comprise modern computer systems, a successful technician must complement this with a range of common, transferrable skills:
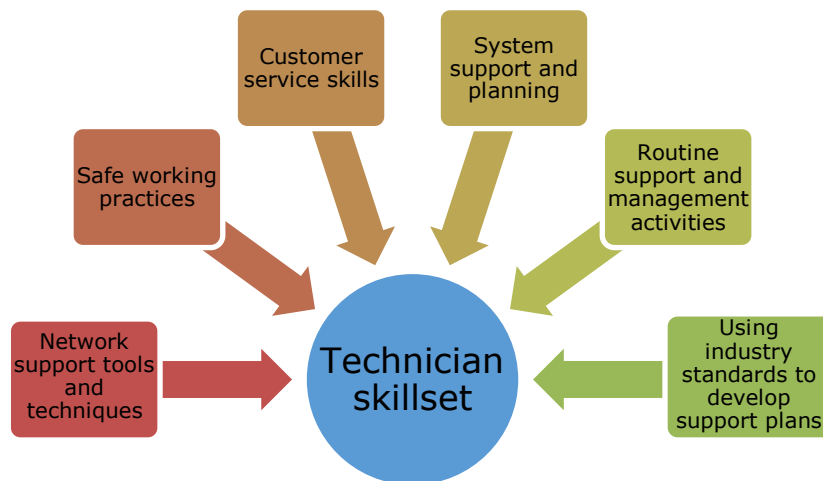


This unit offers learners a rich mix of potential activity types, but primarily the core skills being targeted are those relying on investigation and problem-solving, whether this is examining the IT system support needs of an organisation or carrying out a routine support activity on a problematic IT system.

Ideally, learners should progress through this unit observing professional work practices such as following procedures correctly, documenting findings and actions accurately, and communicating these confidently and appropriately to other stakeholders.

Offering a high degree of 'hands-on' practical activity, the unit will help learners explore and resolve a range of technical issues covering hardware, software (applications and operating systems), administration and networking. As such, it offers many opportunities to complement theoretical content covered in many other units in the programme.

## Approaching the unit

The theoretical content of this unit should be taught in an active fashion using a variety of targeted practical activities, particularly in terms of IT system management and implementation activities or improving the importance of an existing IT system. Where possible, all technologies used (hardware or software) should be up to date, although older equipment is useful as that it may be realistically encountered through the breadth of some larger organisations and workplaces. Ideally, learners should also be exposed to a range of popular operating systems, including Microsoft Windows (client and server), various Linux distributions and Apple Mac OS X. Many popular IT technician software tools are available as open source projects or as freeware and these can offer an acceptable alternative to commercially licensed products. Case studies and reference material relating to IT support incidents and industry best practice should be as current as possible.

All practical activities that involve hardware and software maintenance (particularly the former where electrical hazards are found) should be carried out under strict supervision in classroom (or lab) conditions using recommended safe working practices.

The centre must ensure that all learners have access to appropriate protection equipment and are aware of current regulations, for example, the Provision and Use of Work Equipment Regulations (1998) and the Electricity at Work Regulations (1989), before attempting any investigation or repair.

## Delivering the learning aims

### Learning aim A

This aim requires learners to demonstrate that they can examine the IT system support and management needs and characteristics of different organisations.

This section focuses on the support needs of different types of organisations and the corresponding characteristics of different IT support systems and would be well supported with current case studies involving growth/expansion of services, server issues, and or new hardware and peripheral uptake.

This learning aim is divided into four components with the first focusing on the purpose and nature of IT system support and management and the penultimate one examining the available job roles. Learners are likely to have some experience of technical support through their individual use of technology and this can be expanded to include larger organisational processes such as launching new platforms/interactive services, migrating to cloud services and/or improving security, where the higher education type of services provided by IT technical support and management departments might prove interesting and motivating. Contextualised IT technical support scenarios in sectors such as media, engineering or public service could include the use of industry specialists or guest speakers to propel these topics.

An additional component examines the safe working practices in IT support and management. Learners must be competent with using equipment properly, particularly around devices that can create electrical and fire hazards. Some centres could consider issuing learners with a safe work practice 'driving license' that demonstrates that they are ready to perform IT support and management functions safely. Each successfully studied aspect, for example, DSE, manual handling, PAT and ESD protection contributes to the learner's 'license' to partake in practical sessions.

Learners also have the opportunity to compare the support and management needs of different systems where they can explore practical tasks under controlled classroom conditions. Indeed, many of these aspects are covered in subsequent learning aims, including opportunities to monitor network traffic, set up virtualised clients and servers,

deploy operating systems remotely and control another user's desktop to resolve issues, which are often highly enjoyable and rewarding for learners.

Delivery of this element, though mostly theoretical, should give learners ample opportunity to carry out independent research. This is more likely to develop a better learning environment than chalk and talk.

Sessions around safe working practices would benefit greatly from in-class discussions as well as a visit from in-house health and safety officers, if possible to help demonstrate the practical applications of the theory being learned.

The same is true of network roles and tools – rather than presentation, guest speakers or individuals in similar roles would help give the learners a clear understanding of the roles available to them if following a route of IT technical support. Network tools should be demonstrated and learners should be allowed to engage with them to gain a firm understanding of their applications.

### Learning aim B

This aim requires learners to demonstrate their ability to perform routine support and management activities on IT systems, including monitoring and optimising system performance. This learning aim can be delivered through a number of different practical activities that focus on a wide variety of support activities, system management and optimising the performance of IT systems.

It is strongly recommended that you try to simulate IT support request management by using server-based IT helpdesk software that allow learners to log requests, reply to customers, recommend solutions and track outstanding tickets. Combine this with suitably rotating role play – learners taking turns as customers or technical support – and the learning experience can become very realistic and rewarding, especially when combined with the practical problem solving.

You can differentiate formative assessment opportunities by providing learners with a granular level of difficulty inherent in each reported fault and service request; with this approach even the strongest, most experienced learners will stay actively challenged in sessions.

Learners should also be encouraged to focus on developing their customer service skills and personal behaviours with all stakeholders when engaging in different service support scenarios.

Due to the nature of this learning aim, the majority of teaching, where possible, should focus on practical work and demonstrations. Practically engaging with the different tools and techniques available will give learners ample opportunity to develop the skills necessary to carry out the support and management activities required for this learning aim.

### Learning aim C

This aim requires learners to plan, collaborate, justify, evaluate through the development of a plan to support and manage a new IT system using industry standards and methods.

The best approach for tackling this learning aim is to examine existing IT technical support and management plans, perhaps as part of a larger case study. This will help learners to examine and drill down through each aspect that is required for this type of plan, creating a learner-led checklist that will assist them when completing their own assessments. Giving learners an opportunity to practise creating such plans for a model IT system will also provide adequate preparation for assessment, especially if the feedback given is suitably robust and constructive, especially in terms of its evaluation.
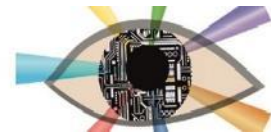
## Assessment criteria (in internally assessed units)

| Learning aim | Key content areas | Recommended assessment approach |
|---|---|---|
| **A** Examine the IT system support needs and characteristics of different organisations, which are essential for their operation | **A1** Purpose and nature of IT system support and management<br><br>**A2** Safe working practices in IT support and management<br><br>**A3** Job roles in IT technical support and management<br><br>**A4** System and network support | A research study of at least two different organisation's IT support and management needs and characteristics. The study should cover four IT support and management characteristics: purpose of the system, safe working practices, job roles and system and network management tools. |
| **B** Carry out routine support and management activities on IT systems | **B1** Management of user support requests<br><br>**B2** Routine support activities<br><br>**B3** System management and implementation activities<br><br>**B4** Performance of IT systems<br><br>**B5** Personal behaviours | Diary or blog of a range of different completed IT support and management activities and other evidence, including customer service response logs, screenshots and photos.<br><br>Observation reports, audio or video recording of user, and client feedback. |
| **C** Develop a plan to support and manage a new IT system using industry standards and methods | **C1** IT system diagrams<br><br>**C2** Incident response and disaster recovery planning<br><br>**C3** Capacity planning<br><br>**C4** Sustainability and environmental waste planning<br><br>**C5** An IT technical support and management plan | An IT support and management plan for a new IT system. |

### Assessment guidance

The assessment for this internally assessed unit would benefit from being divided into three assignments as shown above.

### Assignment 1 (Learning aim A)

A thoroughly researched report focusing on at least two different organisations' IT support and management needs and characteristics. Where possible, draw these organisations from a number of different sectors and represent different sizes, for example, SMEs, medium-sized business or larger corporate entities to provide suitable variety and broader scope of research for the learners. Alternatively, learners could create or deliver a presentation, or the tutor can direct learners in a structured debate.

You should expect learners to cover these four areas:

- Purpose and nature of IT system support and management.

- Safe working practices in IT support and management.

- Job roles in IT technical support and management.

- System and network support and management tools.

To offer the best opportunity for a learner to succeed, they will need to access a range of both published and online sources that provide the academic content, including appropriate regulations.

For distinction criteria, learners will evaluate the support and management needs and characteristics of at least two different IT systems. The systems will be different in their nature, for example, the number of users and the IT skill level of the users might be different.

## Assignment 2 (Learning aim B)

This assignment task is primarily practical in nature but should be presented by the learner as a log. Learners must successfully complete at least six routine IT support activities safely and optimise a computer system's performance to meet the client's requirements, using processes and behaviours effectively.

To meet the client's requirements, it is recommended that a suitable narrative arc is woven which links these support activities and helps to ground them into a realistic workplace scenario. A recommended tactic is to obtain verbal client requests, for example, recorded telephone calls or live role-play interviews to assess the learners' ability to listen closely; in addition, this can generate evidence of learner's professionalism, communication and questioning skills.

Setting up the practical aspect of this assignment will require each learner to have access to a computer system that has deliberately set up with a number of faults or issues (software or hardware in nature) to identify and resolve. Learners may tackle different tasks (if preferred) but they should generally be pitched at the same difficulty level.

Common routine tasks include:

- repairing an installation of a software application

- configuring a user environment, for example, mapping a network drive or changing accessibility options

- modifying an operating system's settings, for example, network connectivity, hard disk partitioning and user permissions

- installing application or software upgrades

- installing a new peripheral's drivers

- replacing a faulty hardware item, for example, sound card, optical drive and video card

- demonstrating a workaround solution for an identified fault

- installing and/or configuring new hardware, for example, printers, scanners and additional monitors

- upgrading existing resources, for example, adding more RAM and additional disk storage or

- performing data backup operations, such as archiving or creating disk images.

Note: The number of concurrent activities is naturally limited through resource availability and safety considerations within the classroom but it is envisaged that learners should be assessed across a range of task types rather than being focused on one type of activity as this better reflects the variety of an IT support technician's real-life workload.

As a requirement for the distinction level, learners should demonstrate they can optimise the performance of a particular computer system (this could be a different computer system, for example, a notebook rather than a desktop system to provide some diversity in the learner's workflow).

Suitable optimisations that could be considered are:

- security optimisation, for example, firewalls, operating system patches and device hardening

- traffic optimisation, for example, resolving system bottlenecks

- basic system performance, for example, firmware (BIOS) and operating system (settings, drivers etc).

To complete this task, learners should have access to:

- administrative rights and permissions on target systems

- diagnostic software, for example, system monitoring software or a range of system utilities

- IT technician toolkit, for example, screwdrivers, needle-nose pliers and multi-meter

- safety equipment that protects both the user and their equipment, for example, ESD wrist-straps and mats

- appropriate diary, blogging or IT helpdesk software.

You should expect learners to demonstrate evidence for:

- actions taken supported by screenshots, photographs or video evidence

- rationale for changes made, particularly in terms of optimisations performed, supported with suitable evidence such as 'before and after' system monitoring

- customer service correspondence through the use of emails, screenshots or photographs

- feedback to client reflected through observation reports, witness statements, audio or video recording.

- time management, including planning, target setting and getting feedback from others

- reviewing and responding to outcomes, including the feedback received from others

- professional attitude to their work reflected in their etiquette, communication, support, leadership and responsibility.
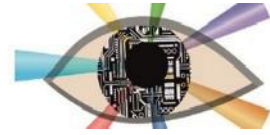
Grade differentiation for this task mainly relies on the level of standard achieved in the following: using processes and behaviours effectively, meeting client requirements, monitoring system performance and optimising system performance.

**Assignment 3 (Learning aim C)**

The final assignment task requires learners to develop and review a plan to support and manage a new IT system using industry standards and methods.

Learners may be introduced to the requirements of the organisation through a written case study, role play (e.g. interview – live or recorded – of a client) or observation of a real workplace.

A suitable example could be that the client established in learning aim B would like the learners to produce and refine a plan to support and manage a new IT system. This could be presented as a new business moving to the local area that needs their IT infrastructure securely in place before starting up.

The plan should be presented as a formal report and minimally you should expect it to include sections on:

- disaster recovery

- incident response

- capacity management

- sustainability and environmental management.

Other aspects that the learners should tackle include:

- ergonomics

- floor plans

- IT service outsourcing requirements

- IT services procedures and policies, for example, fault and issue report, escalation and acceptable usage.

The plan should use diagrams (e.g. route maps, upgrade paths, schedules, checklists), wherever appropriate and make references to current standards (e.g. ISO/IEC 27031), concepts (e.g. RPO and RTO) and legislation (e.g. Waste Electric and Electronic Equipment (WEEE) Regulations 2013), as applicable.

This report should be then reviewed by others (e.g. peers, assessor, other members of the programme delivery team or industry experts) and the learner should use this feedback to identify flaws, make improvements and justify how well their plan meets the client's requirements and whether it is actually fit for purpose.

Grade differentiation will focus on the standard of problem solving, that is, how well the learner has interpreted the client brief to support and manage a new IT system, the underlying quality of their plans, their application of feedback (to identify and inform improvements) and the standard of evaluation provided.

For distinction standard, learners will evaluate their refined IT support and management plan and will consider the feedback from others. They will provide evidence of the feedback they have obtained and show how they have used it.

# Getting started

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

## Unit 12: IT Technical Support and Management

### Introduction

Introduce this unit by ascertaining the learners' experience with IT technical support (most will have had some interactions with a technical help desk at some point) and detail the full expectation of the unit's outcomes and the skills (and professional behaviours) the learners are expected to develop before its completion.

Give learners the titles of different network support roles to research and feed back to the class on the description and duties of the roles. This will give an overview of the IT sector, and the number of entry-level roles available for support technicians is a useful motivating factor; gauging learner interest levels in pursuing such a route post-qualification can also be beneficial.

You may consider measuring initial learner skills by using a simple skills and behaviours audit, permitting the creation of individualised starting points based on prior experience. This would help you manage practical sessions more appropriately, spending limited support time in the most efficient manner. Repeat this process at the end of the unit using the same document to measure distance travelled.

Introduce learners to the concept of risk assessments in the work placements and ask them to carry out their own in the classroom/their home. Give learners specific scenarios for a range of employees and ask them to consider the most suitable outcome, e.g. manual handling training, PAT testing of equipment, Hazard mitigation methods.

You may also consider appointing (or asking for volunteer) learners with more experience to act as classroom support.

## Learning aim A – Examine the IT system support and management needs and characteristics of different organisations, which are essential to their operation

### Learning aim A1 – Purpose and nature of IT system support and management

You will detail purpose and nature of IT system support and management.

- Present the main purpose of IT system support and management – this is a good opportunity to ask learners to discuss why they think support and management of IT systems is important. Encourage learners to discuss large scale impacts such as banks being unable to operate as well as security issues that affect them directly, e.g. PSN network being down.

- Discuss the support and management needs of an organisation and how it varies across the system's life cycle (this can be linked to themes in other units), including newer (and growing) initiatives such as bring your own device (BYOD).

- Ask learners to create a five-stage system life cycle poster (design, build, test, operate and decommission) where they link IT system support and management functions to each stage, e.g. decommissioning would involve archiving and migrating system data and recycling hardware appropriately.

- Discuss the nature of IT system support and its resource types, demand cycles, compromises which affect its policies and processes and how its operation and scope varies depending on the sector it occurs, e.g. office and engineering sector needs being similar but having unique challenges. Inviting guest speakers from IT

technical support functions based in different sectors is a useful tactic as it allows learners to compare and contrast the situational scope of their respective roles and responsibilities.

● Learning aim A1 should take approximately 2 hours.

**Learning aim A2 – Safe working practices in IT support and management**

You will discuss and demonstrate (where possible) safe working practices in IT support and management.

● Ask learners to research and feed back on the safe working practices for the use and care of IT equipment in organisations, including legislation such as:

   o Health and Safety (Display Screen Equipment) Regulations 1992 (as amended 2002)

   o Manual Handling Operations Regulations 1992 (as amended 2002),

   o Portable appliance testing (PAT) – the Provision and Use of Work Equipment Regulations 1998

   o Electricity at Work Regulations 1989.

● Ask learners to précis these pieces of legislation, possibly summarising them through the creation of a wiki, podcast or in-class poster.

● Explore suitable case studies or reported incidents of effects on organisations where safe working practices have not be followed. Ask learners to discuss these and see if these could have been avoided.

● Show a suitable Health & Safety video (or ask for a specific presentation from the institution's Health & Safety representative) which demonstrates the specific health and safety hazards encountered when working in an IT support environment.

● Demonstrate and ask learners to participate in the use of hazard mitigation methods, e.g. ESD wrist strap, ESD mat, firefighting equipment and training, first-aid training. Third party expertise, e.g. local fire and rescue resources or the local designated first aider may assist, if asked.

● Learning aim A2 should take approximately 3 hours.

**Learning aim A3 – Job roles in IT technical support and management**

You will detail and differentiate the typical job roles in the IT technical support function, which includes the following.

● Different support levels, e.g. 1st, 2nd and 3rd lines

   o Ask learners to research and present to the class the responsibility of each support level giving example duties and responsibilities.

● The role of infrastructure architects

● The role of network administrators and their contribution to 2nd and 3rd line support.

   o When explaining the job roles and duties of infrastructure architects and network administrators, it is often useful to employ the use of guest speakers (possibly from the institution's own support function), workplace visits or work experience.

● Learning aim A3 should take approximately 3 hours.

**Learning aim A4 – System and network support and management tools**

You will discuss, demonstrate and manage learner-led classroom activities which detail the following.
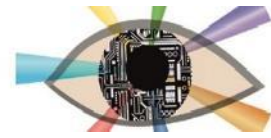
- Give learners (in groups) one of a range of network performance monitoring and management tools, particularly those which focus on bandwidth and application monitoring and network scanners (e.g. wireshark) for protocols and ports. Learner groups prepare informative posters on their tools to be displayed in the classroom – these can help with summative assessment later in the unit.

- Provision of user desktop computing by various means, including server virtualisation with thin client computing and web-based applications (e.g. vagrant and virtual PC).

- Introduce learners to tools used to create and remotely deploy desktop disk images – this could be done via a demonstration through in-house IT support, where learners can take notes for future reference.

- Asset management, including the use and registering of software licences.

- Remote desktop access and control and administration, including performing updates of both operating systems and applications.

- Learning aim A4 should take approximately 3 hours.

## Learning aim B – Carry out routine support and management activities on IT systems

### Learning aim B1 – Management of user support requests

Demonstrate how learners should carry out routine support and management activities on IT systems using best practice

- Describe the source of user support requests, e.g. forgotten login details, lack of user training, hardware or software faults and the impacts these have on the function of the organisation.

- Present a breakdown of IT support and management processes, including:

  o issue and fault management (support tickets, severity and priority concepts, request classification, job allocation, escalation and communicating with the user)

  o the role of SLA (service-level agreements) in monitoring the IT support function load, overall performance and responsiveness

  o gathering user satisfaction levels as feedback and informing further improvements

  o tracking resource requests:, identify fault trends, analysis of skills needs and required staffing levels

  o desirable and undesirable aspects of communication, e.g. being attentive when listening to a user, demonstrating empathy and providing factual information. Learners could summarise these as part of a person's specification for an IT helpdesk job.

- The use of open source IT helpdesk ticketing systems can be beneficial here as a form of simulation and role play, allowing users to directly respond to users, solve problems and report back using a realistic software solution. This could be a good opportunity for learners to experience the in-house help desk facility for IT support.

- Discuss the importance of IT support and management systems, covering reporting systems, types of information that should be reported per fault (including actions and outcomes) and the role and content of knowledge bases. Providing learners with examples of real-life IT fault logs to explore can be particularly beneficial.

- Learning aim B1 should take approximately 6 hours.

## Learning aim B2 – Routine support activities

You will detail routine support activities.

- Demonstrate and ask learners to replicate practically a range of routine support activities for a range of different IT systems. Learners should be as involved as possible with these demonstrations, with others recording if possible, these activities should include the following.

- Issue and fault logging and management

- Communicating with users

- Performing routine support and repair tasks, e.g.

    o installing applications software

    o updating drivers for a non-functioning peripheral

    o configuring a user's environment

    o changing an IT system's basic configuration, e.g. BIOS or operating system settings

    o creating a new user account, setting and adjusting its permissions

    o creating and deploying workaround solutions.

- Analysing system data to identify problem areas and trends, e.g. using a set of helpdesk reports to identify and calculate hard disk failure rates from a particular manufacturer or a number of similar user requests that may indicate a need for additional user training and staff development.

- Learning aim B2 should take approximately 8 hours.

## Learning aim B3 – System management and implementation activities

You will detail system management and implementation activities.

- Demonstrate and ask learners to replicate practically a range of system management and implementation activities for a range of different IT systems, including:

    o System installation

    o Upgrades (RAM, hard drive, additional expansion cards, etc)

    o Adjusting system settings on a range of devices

    o Storage management, including backup and restore of data

    o Software management, including installation, configuration, updation and removal

    o Disk configuration, including mapping network shared drives, creating disk images, setting and changing folder permissions.

- This activity can be managed using pairs or small groups, rotating through a series of round-robin practical activities. Log each learner's successful completion of each task using an individual learning plan or personal development log.

- Learning aim B3 should take approximately 5 hours.

## Learning aim B4 – Performance of IT systems

Discuss and demonstrate to learners the performance of IT systems, how it can be monitored, measured and improved through various forms of optimisation.

- Demonstrate and ask learners to try various forms of security optimisation, e.g.

- o firewall configuration (MAC filtering, encryption, reserved IPs, NAT etc)

- o access control rules

- o common vulnerabilities and exploits (CVEs) and how to deploy patches

- o device hardening, e.g. removing redundant services and moving services to non-standard ports

- o management of system permissions.

- Identify typical ways to optimise system traffic and how to check performance (at rest, under load); identification of system bottlenecks and possible solutions, e.g. more RAM, improved CPU, optimised operating system and improved drivers.

- Discuss techniques for improving system performance including common techniques and upgrade options with suggestions sourced from the learners.

- Demonstrate automated system monitoring techniques

- Ask learners to identify and practise performing certain optimisations under controlled conditions, documenting their findings with analysis of the improvements made.

- Learning aim B4 should take approximately 7 hours.

## Learning aim B5 – Personal behaviours

- Help learners to reassess their professional behaviours. Learning aim B5 should take approximately 2 hours.

- Recap the personal behaviours that are intrinsic to the IT support and management function, e.g. time management, planning, setting targets and gathering feedback

- Reflect on how behaviours impact outcomes, especially the impact of:
  - o being professional
  - o having good etiquette
  - o using good communication
  - o being supportive
  - o taking leadership
  - o acting responsibly.

- You should now reissue the skills and behaviours audit completed by learners in the first session so that they can now revisit the document and make additional observations about where and how they feel they have improved. Learners may also find it useful to reference their ILPs when completing this task.

- Learners should use the internet (or the centre's own learning centre resources if any exist) and identify sources such as videos or other materials that would help them to improve the skills they identified as those need improvement. A combined list of resources from all learners should be published and/or shared by the class.

## Learning aim C – Develop a plan to support and manage a new IT system using industry standards and methods

### Learning aim C1 – IT system diagrams

- You introduce learners to the concept of IT system diagrams and the different types commonly used. Learning aim C1 should take approximately 3 hours.

- Introduce, describe and decompose different types of IT system diagrams, including:

- o route maps
- o upgrade paths
- o schedules
- o Gantt Charts
- o network performance monitoring
- o maintenance checklists.

- Lead a directed question and answer session, asking small groups of learners to take turns (round-robin style) interpreting IT systems diagrams of each type.

- Task learners with creating different types of IT systems diagrams for given scenarios, e.g. from a verbal interview describing an intended hardware and software upgrade path of a given organisation in the upcoming 5 years.

    Note: Some products can make use of practical resources to create electronic documentation, e.g. Gantt charts using commercially available products such as Microsoft Project or online Gantt Chart creation tools.

## Learning aim C2 – Incident response and disaster recovery planning

Introduce learners to incident response and disaster recovery planning

- Discuss the importance of organisation continuity planning in accordance with the current ISO/IEC 27031 or other relevant international equivalents.

- Present how incidents should be managed, including:
    - o their identification
    - o their classification
    - o prioritisation
    - o how to minimise their impact on the business
    - o use of workaround solutions.

- In groups, give learners the same sets of incidents that they need to rank in the order of classification and prioritisation – each choice must be justified. The class then should discuss each group's findings and see how plans and perceptions can differ.

- Introduce metrics for continuity, security and readiness for a potential disaster, including recovery time objective (RTO) and recovery point objective (RPO).

- Discuss backup planning and the best use of site mirroring.

- Detail disaster recovery procedures and planning involved for unexpected downtimes.

- Examine case studies to reinforce learning and contextual incident response and disaster recovery planning concepts. Ask learners to examine case studies in groups.

- Learning aim C2 should take approximately 2 hours.

## Learning aim C3 – Capacity planning

Introduce learners to the concept of capacity planning.

- Present the basic concepts involved in the active planning and management of capacity of a given period, e.g.
    - o Calculating required capacity based on factors such as type, location, concurrent users and working hours. Learners could be asked to perform basic calculations

of these based on simplified case studies.

  o How to practically optimise network systems and assets to provide better value for money, e.g. network printing, shared folders and use of thin clients. Learners must have an opportunity to implement some of these resourcing techniques on a quarantined network to observe their impact on capacity, costs and available resources.

  o Stressing the importance of checking system requirements, the ability of an IT system to scale, its availability and suitability for public, private or hybrid cloud-based solutions and the impact this may have on the overall customer experience.

  o Monitoring a system over time to check capacity and performance over a system's life cycle, identifying bottlenecks, peaks, spikes and troughs in activity levels. Learners could be asked to identify causes of bottlenecks or unusual activity levels and, perhaps, calculate capacity trends of a given organisation moving forward (e.g. doubling workforce or opening a new office) and, if possible, make suitable planning recommendations.

- Learning aim C3 should take approximately 2 hours.

## Learning aim C4 – Sustainability and environmental waste planning

Introduce learners to the role of sustainability and environmental waste planning when working in IT technical support and management

- Discuss the concept of sustainability and environmental waste planning, particularly in terms of practical considerations such as:

  o reduction of waste with recycling or repurposing

  o repair of hardware and software instead of replacing

  o source products that reduce carbon and

  o implementing a remote-work policy and enabling it through technologies such as VPNs to reduce travel (and associated carbon emissions).

- Discuss the practical aspects of environmental management:

  o on-site IT system effects

  o recycling, including legislation such as Waste Electric and Electronic Equipment (WEEE) Regulations 2013 or other international equivalents.

- Ask learners to investigate sustainability and environment waste planning and policy for given organisations.

- Task learners with generating their own sustainability and environment waste planning policies, obtaining feedback from their peers after presenting them.

- Invite guest speakers who specialise in recycling of electronic goods, especially old IT systems, to partake in moderated question and answer sessions.

## Learning aim C5 – An IT technical support and management plan

Discuss and walk through an IT technical support and management plan.

- Discuss the purpose and scope of an IT technical support and management plan, i.e. what is included and what is not.

- Detail the common sections of an IT technical support plan, e.g.

  o disaster recovery

  o incident response
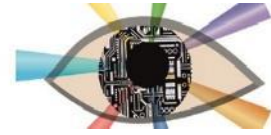
- o capacity management
- o sustainability and environmental management.
- Highlight other aspects that the learners should tackle include:
  - o ergonomics
  - o floor plans
  - o IT service outsourcing requirements
  - o IT services procedures and policies, e.g. fault and issue report, escalation and acceptable usage.
- Ask learners to work through a sample IT technical support and management plan, identifying aspects which have poor, average and good coverage.
- For a given scenario, tasks small groups of learners to create a suitable IT technical support and management plan, presenting these to their peers for feedback.
- Ask each group to recommend improvements to their plan based on received feedback.

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

- Unit 1: Information Technology Systems

- Unit 2: Creating Systems to Manage Information

- Unit 9: IT Project Management

- Unit 11: Cyber Security and Incident Management

- Unit 14: IT Service Delivery

- Unit 15: Customising and Integrating Applications

- Unit 16: Cloud Storage and Collaboration Tools

- Unit 19: The Internet of Things

# Resources

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

### Textbooks

Bruton N, *How to Manage the IT Helpdesk,* Routledge, 2002 ISBN-10 0750649011, ISBN-13 9780750649018

Clarke GE, Tetz E and Warner T, *CompTIA A+ Certification All-in-One For Dummies* (Fourth Edition), John Wiley & Sons, 2016 ISBN-10 1119255716, ISBN-13 9781119255710

Meyers M and Wempen F, *Mike Meyers' CompTIA A+ Guide to Managing and Troubleshooting PCs Lab Manual* (Fifth Edition) (Exams 220-901 & 220-902), McGraw-Hill, 2016 ASIN B01DTOOS3S

Sanchez A, *Technical Support Essentials* (First Edition), Apress, 2010 ISBN-101430225475, ISBN-13 9781430225478

### Videos

Manual Handling 8 basic steps to correct lifting technique (www.youtube.com/watch?v=RuhHroEh31i0)

1st Line Support Process (www.youtube.com/watch?v=BTtfSlMqpoQ)

### Websites

https://ganttpro.com/ – Ganttpro – Online Gantt chart software for project management

www.hse.gov.uk/waste/waste-electrical.htm – Waste Electrical and Electronic Equipment recycling (WEEE)

http://osticket.com/ – OSTicket – A simple and lightweight open-source support ticket program designed to be easy to install and set up

www.vagrantup.com – HashiCorp Vagrant – Create and configure lightweight, reproducible and portable development environments
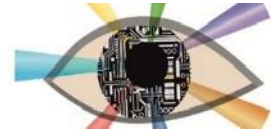
www.virtualbox.org – Oracle VirtualBox – An Intel x86 and AMD64/Intel64 virtualization product for enterprise as well as home use

www.wireshark.org – Wireshark – A network protocol analyser for Unix and Windows

*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.*

# Unit 13: Software Testing

## Delivery guidance

This unit presents learners with the engaging challenge of first evaluating different testing methodologies before moving on to test a software development project to assure their performance and overall quality before release.

Without doubt, testing is a critical part of the software development life cycle and its impact on the overall success of a project simply cannot be ignored.

Done well, testing provides customers and users with a product that they can use with confidence, minor and major bugs having been identified and fixed through appropriate change controls and comprehensive testing.

However, bringing poorly tested code to the marketplace can lead to a financial loss, reputational damage and, potentially, a client's irreversible loss of confidence in the developers and the product.

Indeed, in some extreme cases such as aviation, traffic management and safety systems, it is possible that a simple undocumented software bug could actually lead to loss of life.

The key to becoming a successful software tester relies on four interlocking core skills:

Of course, there are many different methodologies and tools (automated and manual) that can be used to test a software; knowing which is the most appropriate to use is not always immediately obvious – it is a developed skill, pushing learners' analytical and problem-solving abilities to the highest levels.

Learners will also find themselves needing to refine their communication, analysis, evaluation and presentation skills, as reviewing and presenting the results from the software tests to an emotionally invested (and possibly very resistant) development team is a core aspect of this unit.

Learners wishing to pursue a programming career could be encouraged by reminding them that software testing is a well-trodden path towards a full-fledged software development career.

## Approaching the unit

This unit lends itself to a three-fold approach to learning:

- research-based investigation into different software development and testing methodologies commonly used during the development life cycle to quality assure software

- practical testing of a software product using a range of appropriate testing methodologies

- analysis and presentation of test results to the development team, offering areas for improvement by evaluating characteristics of testing, methodologies and software products.

Learners are likely to enjoy the problem solving aspects of the unit as identifying bugs and errors in a program's code and behaviour is typically a satisfying experience.

Many different automated tools exist to test software products, particular web-based solutions and learners should encounter a wide range of these during their studies, both commercial and open source. Where possible try to link practical testing to actual software development (mobile, desktop, application, web-based or hybrid) taught in other units, possibly even using products from those sessions as 'live' case studies.

Ideally, this unit could be delivered alongside, or after, *Unit 4: Programming* and *Unit 9: IT Project Management*. Other potential links include *Unit 6: Website Development*, *Unit 7: Mobile Apps Development*, *Unit 8: Computer Games Development*, *Unit 15: Customising and Integrating Applications* and *Unit 19: The Internet of Things*.

Any opportunities to involve local employers as clients will enhance both the unit and the learner experience, particularly in terms of working with a live software development brief.

### Learning aim A

Learners need to understand both: the different functions that software needs to perform and the processes of software development and people/skills engaged in each stage of the process.

Initially, you will focus on the purpose of the software and the user requirements. Then learners should be directed to the process of development and the typical job roles that exist in the field of software development. Coverage of a wide variety of job roles will help learners appreciate the range of skills utilised and, possibly, its career progression pathway.

To cover the features of software testing and methodologies, an independent research may be beneficial. Learner can produce an outline of each feature and methodology and

produce informative posters on them – these can be used in the class room to help others at a later date.

Perhaps the best way to understand user requirements is to examine sample project briefs that demonstrate the functional requirements that a software development team has been expected to resolve. Alternatives include briefs where user requirements are requesting additional or revised features (to resolve problems in an existing system) or simply existing processes that need to be optimised.

An examination of most online IT sector recruitment websites will reveal a wide range of software development roles. Typically each has a detailed job description that not only lists the required technical expertise but also outlines the responsibilities of the post. Encouraging learners to use these sites as a reference point is recommended. In addition, you will find similar content to brief learners at the Tech Partnership, a network of employers working to create skills for the UK's digital economy. Guest speakers working in these roles in industry (possibly previous learners) are also a useful addition to any presentation.

By the completion of this learning aim learners should understand the typical contents of a user requirements list and the roles connected to the process of testing, including implicit ones such as the actual product owners.

The next sub-aim involves an examination of the different types of software testing, their applications and outputs. The content breaks this range of software testing into nine different sub-categories, although, in truth, you may find some commercial and open source products that span multiple categories. Some examples of available open source windows application testing software include AutoIT and Winium. Learners should be able to name each form of testing, describe its purpose and how each is implemented and who is typically responsible for performing the test. Some simpler test methodologies, e.g. unit testing can be routinely performed in other units, offering opportunities for a more holistic delivery approach. Others such as penetration testing are very involved and have coverage in topics outside the normal software development family of units, e.g. learning aim C, *Unit 11: Cyber Security and Incident Management*.

The final part of learning aim A focuses on evaluating the features of different software development methodologies, specifically including Agile, Waterfall and Kanban. Although others exist, it is advised, given their complexity, to limit coverage to these three named examples. Without suitable frames of reference, this topic can prove to be a very nebulous concept for learners. Having a guest speaker, preferably a developer/programmer or a project manager explaining the methodology they use in their workplaces and how it works on a day-by-day basis during the development of a new product is probably the most effective and grounded approach possible.

### Learning aim B

The second aim primarily focuses on the preparation, planning and physical act of testing a software product. You can simplify this as a four-stage process:

- knowing how to set up common testing tools and processes

- selecting the appropriate test methodology/methodologies for a given software product

- creating a test plan

- testing the product (following the test plan with the appropriate test methodology/methodologies).

Learners should be encouraged to work methodically through this process, documenting each stage completely before continuing. You should create suitable test scenarios (using different test methodologies) for learners to practise before summative assessment occurs. It would be beneficial for learners to keep an ongoing log of testing and results to ensure an organised approach.

## Learning aim C

The final learning aim focuses on evaluating the test results and presenting findings to the development team.

A suggested generic approach could be:

- compare passed, failed and skipped tests

- identify undocumented bugs (i.e. those not known to development team)

- make evaluation with recommendations

- present the findings (using a variety of communication skills and media)

- add new test cases based on new bugs

- plan regression testing

- repeat the presentation of findings.

Learners should be supported when approaching the challenge of evaluating outcomes effectively as this is typical of a higher-order skill. This could be done by completing a class wide evaluation of a separate set scenario. This will ensure learners are aware of the requirements and processes involved in evaluation. Typically this can become limit grade expectations. Where possible encourage learners to practise their evaluative skills using sample products and tests. In addition, the presentation of findings and the expected mixture of media (written word, verbal and graphical information such as charts and diagrams) can prove challenging. Again, preparation and practice is a key objective here, so learners should be given repeated opportunities to practise the presentation of findings effectively, paying particular attention to their tone, language and the use of jargons. Above all, remind learners that testing is a positive activity and its aim is to improve a product, not be used as a tool to punish developers; a constructive feedback is vital.

Again, having learners present to external parties can be a particularly invigorating and effective tactic.

## Assessment model (in internally assessed units)

| Learning aim | Key content areas | Recommended assessment approach |
|---|---|---|
| **A** Understand the software development and testing methodologies commonly used during the development life cycle to quality assure software | **A1** User requirements and typical software project job roles<br><br>**A2** Characteristics of common software testing methodologies<br><br>**A3** Features of testing for different software development methodologies | A report into the characteristics of different testing methodologies used in two different software development projects and how the choice of project methodology affects the testing method, software product, user requirements and team members |
| **B** Carry out a range of testing methodologies on a software product to meet a client's needs | **B1** Common tools and processes used in software testing<br><br>**B2** Selecting appropriate test methodologies<br><br>**B3** Test plan<br><br>**B4** Product testing | A portfolio of evidence from testing a software product. The evidence should include an overview of testing tools used, why the methodology was chosen, test plans and the results of product testing. |
| **C** Review and present the results from software tests to meet a client's needs and suggest improvements | **C1** Test evaluation and presentation of results<br><br>**C2** Test plan improvements | A written summative report on the testing carried out and the results of the testing. Statistical analysis on time taken to test bugs and pass/fail/skip rates. Additions to test plan, to include newly found bugs that were not initially considered in the preparation stage |

## Assessment guidance

The assessment for this internally assessed unit would benefit from division into three assignments as shown above.

### Assignment 1 (learning aim A)

A thoroughly researched report, discussing the characteristics of different testing methodologies used in two different software development projects and how the choice of project methodology affects the testing method, software product, user requirements and team members. Alternatively, learners could produce and deliver a presentation on these characteristics and methodologies.

Potentially, software projects could be selected from the current/previous learners' work in other units, e.g. *Unit 4: Programming*, *Unit 6: Website Development* or *Unit 7: Mobile Apps Development*. Opportunities therefore also exist to assess elements of different assessments in an integrative fashion, depending on the delivery timings and unit composition of the learners' programme of study.

Things to remember to offer the best opportunity for learner success:

- Learners must have access to a developed software program with a clear specification (based on the user requirements).

- Learners will need to access a range of both published and online sources to provide the academic content.

## Assignment 2 (learning aim B)

This assessment requires learners to carry out a range of testing methodologies on a software product to meet a client's needs. In order to develop a systematic approach to developing a portfolio, learners should keep accurate ongoing logs of the work they carry out.

Things to remember to offer the best opportunity for learner success:

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

- Access to appropriate hardware, software and tutorials is required in order for learners to test selected software projects. This could include:

  o web services, e.g. SoapUI or a free alternative

  o test management software, e.g. Tarantula (free), and TestLodge and HipTest (commercial and paid for alternatives).

- Learners will need to access a range of both published and online sources to provide the academic content.

- Distinction level learners need to perform a comprehensive and appropriate range of tests systematically and meticulously on a software product against the user requirements, using an effective test plan.

## Assignment 3 (learning aim C)

This assessment requires learners to write a summative report on the testing carried out on a chosen software development project and the results of its testing. They should provide statistical analysis on time taken to test bugs and pass/fail/skip rates. Additionally, they should identify non-documented bugs and prepare for further regression testing through the identification of reasoned improvements. For higher grades, present a cohesive and clear evaluation of the results of testing using graphical and written methods; compare the passed, failed and skipped tests; and suggest reasoned improvements to the test plan.

Ideally, the written report should be presented by the learner to a member of the development team.

Things to remember to offer the best opportunity for learner success:

- You should also expect higher achieving learners to demonstrate their individual responsibility by providing clearly documented evidence of their work, creativity and self-management during the process.

- Learners should have the ability to represent numeric data in graphical format using charts and diagrams where appropriate.

- Learners should present their findings in a clear, concise and unambiguous manner that meets the needs of the development team members.

- Learners will need to access a range of both published and online sources to provide the academic content.
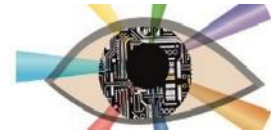
# Getting started

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

## Unit 13: Software Testing

### Introduction

Introduce this unit by ascertaining the learners' experience with programming and using software (via class discussion), particularly their experiences of programs behaving badly, e.g. freezing, crashing, working slowly or calculating the wrong answer and detail the full expectation of the unit's outcomes and the skills (and professional behaviours) it is hoped the learners will develop before its completion.

Providing an overview of the IT sector and the number of entry-level roles available for software developers and software testers is a useful motivating factor; gauging learners' interest levels in pursuing such a route post-qualification can also be beneficial. Learners performing an independent research and feeding back findings may be an engaging approach.

You may consider measuring initial learner skills by using a simple skills and behaviours audit, permitting the creation of individualised starting points based on the prior experience. This would help you manage practical sessions more appropriately, spending limited support time in the most efficient manner. Repeat this process at the end of the unit using the same document to measure the distance travelled.

**You may also consider appointing (or asking for volunteers) learners with more experience, particularly those with stronger programming skills, to act as classroom support.**

### Learning aim A – Understand the software development and testing methodologies commonly used during the development life cycle to quality assure software

### Learning aim A1 – User requirements and typical software project job roles

You will discuss both the software purposes (i.e. what is it intended to do? How does it improve work flow?) and the job roles in the process with regard to developing, checking etc.

- Outline the basic user requirements; typically this can be achieved by:
  - o investigating software development project briefs
  - o examining real-world scenarios
  - o interviewing potential clients and ascertaining their requirement types, e.g. whether they want a new functionality or problems with the current system or a specific process improved.
- Ask learners to investigate roles associated with a software development project, including members of its team and its stakeholders. The use of online recruitment agencies or sector-specific job recruitment companies and trade adverts often provides a useful source of reference, along with suitable sector bodies, e.g. The Tech Partnership. Learners could then present their findings to their peers, creating a definitive checklist.
- This learning topic should take approximately two hours.
- Review the learner topic using directed question and answer techniques during a suitable plenary.
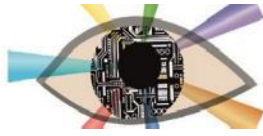
## Learning aim A2 – Characteristics of common software testing methodologies

You will introduce the different types, application and output of different software testing methodologies by getting learners to research each of them and present the findings to the group.

- Identify each of the different types, e.g. unit testing, acceptance testing and functional testing by presentation and discussion with the class.

- For each type, detail:
  - What each test is designed to prove or identify, e.g. security flaws and meeting client expectations.
  - How each test is created.
  - How each test is performed.
  - Who performs each test (e.g. client, target users and development team).
  - At which part of the software development lifecycle is the testing performed, i.e. not all are auctioned during the traditional testing phase, some could occur during development (e.g. unit testing) and others in post-development (e.g. performance testing).
  - What form the outputs from each type of testing actually take.

- Select a suitable case study with sufficient scope, documentation and available sample code, and demonstrate how to apply each type of tests.

- Ask learners to tackle each type of testing with a similar case study.

- This learning topic should take approximately six hours.

- Review the learner topic using directed question and answer techniques during a suitable plenary.

## Learning aim A3 – Features of testing for different software development methodologies

You will introduce different software development methodologies and how testing is applied with them, e.g. Agile (scrum) development, Waterfall development and Kanban development. This could be done by presenting different development projects and working through each development methodology as a class – this will enable the class to see the benefits of different approaches.

- Present each software development methodology:
  - describe its basic characteristics
  - discuss its distinct advantages and disadvantages
  - describe when each software development methodology is typically employed
  - describe how testing occurs within each methodology.

- Ask learners to create a poster, podcast or wiki that provides a basic comparative overview of each software development methodology discussed.

- Task learners with examining a number of different businesses and software development needs and ask them to select an appropriate software development methodology, justifying their selections to their peers.

- Reveal model answers and give feedback to learners.

- This learning topic should take approximately eight hours.

- Review the learner topic using directed question and answer techniques during a suitable plenary.
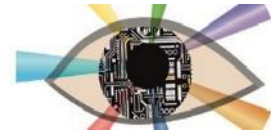
## Learning aim B – Carry out a range of testing methodologies on a software product to meet a client's needs

### Learning aim B1 – Common tools and processes used in software testing

You will detail the common tools and processes used in software testing. This will involve:

- Demonstrating how different testing tools are used – while giving learners an opportunity to try tools themselves, including:
  - How different tools record information, e.g. text based and automation tools.
  - Ask learners to investigate the advantages and disadvantages of each type of testing tools, including ease of use, production of meaningful audit trails and their reporting functionality. Learners could create a table of comparison to summarise their findings or present them to their peers.
  - Demonstrate how automated tools can be used to test developer projects, particularly those under source control, e.g. versioning software such as Git and SVN. For example, this may require the build of a test server with appropriate versioning, hosting software and testing tools for a web-based project.
  - Discuss the role of external testing companies and debate their relative advantages and disadvantages.
- Present a breakdown via the presentation of testing processing which includes:
  - quality assurance processes for dealing with software bugs, e.g. description, steps to reproduce, affected version, fix version, actual result, expected results and importance/severity (minor, major and critical)
  - Change requests, including policies.
  - debugging of program code
- For each type of test processes, describe its purpose and where possible demonstrate and encourage learners to duplicate the process. A possible activity flow which links all types could encourage learners to:
  - identify a bug in a software project (the complexity of this can be differentiated for learners' abilities)
  - follow and apply the correct quality assurance process
  - complete a change request
  - Debug the program code and fix it.
  - review the completed testing processes.
- This learning topic should take approximately five hours.
- Review the learner topic using directed question and answer techniques during a suitable plenary.

### Learning aim B2 – Selecting appropriate test methodologies

You will detail and (where possible) demonstrate different test methodologies.

- Identify and describe different types of test methodologies, i.e. Service testing, e.g. Simple Object Access Protocol (SOAP) and Representational State Transfer (REST) services:
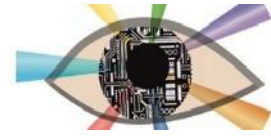  - application testing
  - automation testing

o regression testing.

- Demonstrate different test methodologies using commercially available or open source suites and tools. The reputational complexity of the tool should not be a limiting factor here; choose a suite or tool that is most accessible for learners, allowing the core principles of the methodology to be easily highlighted, e.g. Selenium. This is a popular and portable software testing framework for web applications, released under the Apache 2.0 license that can be installed and configured within a reasonable timeframe.

- For each test methodology, it is important to distil its most significant features and characteristics, particularly in terms of linking these to possible applications.

- This learning topic should take approximately five hours.

- Review the learner topic using directed question and answer techniques during a suitable plenary.

## Learning aim B3 – Test plan

You will demonstrate the correct contents of a test plan, including the selection of the test methodologies most suitable for a given software project and the creation and documentation of suitable test scripts.

- For a selected sample software development project, walk learners through the process of selecting the most appropriate test methodology and for each of these, the content of each test script including:

  o title, e.g. 'Viewing paginated transactions for a given customer account'.

  o description of the test case, e.g. 'Test script to see if the bug fix for customer account pagination is working correctly'

  o steps required to produce the test case, e.g. sequence or combinations of user actions (e.g. for a customer portal: logging in, selecting a customer account and viewing transactions) and/or situations that need to exist (e.g. a customer account having more than 100 transactions)

  o expected result, e.g. transactions are displayed for the selected account in batches of 10, with a navigable page list displayed. Customers are then able to freely move forward or backward through the transaction list without any errors

  o actual result, e.g. what occurred, screen capture, video capture or observation report

  o importance of test, e.g. why the test has been chosen, e.g. to illustrate its importance within the functionality of the project (e.g. it's a basic customer function) or to demonstrate the resolution of a previous bug (e.g. there was no effective pagination previously).

- Pair learners and task them with creating a suitable series of test scripts for a sample software project, identifying typical areas to test and completing the appropriate details for each.

- Ask learners to review their peers' efforts.

- Give feedback, highlighting any gaps in coverage, e.g. significant logical/functional areas not identified.

- This learning topic should take approximately three hours.

- Review the learner topic using directed question and answer techniques during a suitable plenary.

## Learning aim B4 – Product testing

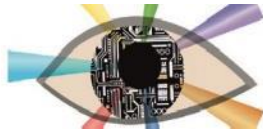You will discuss the concept of product testing, particularly in reference to:

● acceptance testing, including breaking down a specification into a number of user requirements, each identified by a unique number

● regression testing

● role-play elements of acceptance testing with learners playing the role of project clients and testers

● Practise regressing testing using a sample software development project.

● Learners should exhibit a systematic approach to testing using a test plan.

● This learning topic should take approximately four hours.

● Review the learner topic using directed question and answer techniques during a suitable plenary.

## Learning aim C – Review and present the results from software tests to meet a client's needs and suggest improvements

### Learning aim C1 – Test evaluation and presentation of results

You will discuss and lead a session for learners, demonstrating how to review and present the results from software tests. Detail each of the items that would be expected in the test evaluation and presentation of the results, e.g.

● A summary that includes an overview which tests were passed, which failed and those that were skipped (and the reasons why).

● raising the issue of undocumented bugs which testing has revealed

● How to present effectively, utilising good communication skills, paying attention to:

  o Ensuring that communication is clear, whether delivered verbally or in written format and there is no room for ambiguity in statements made. Provide examples of good and bad statements and ask learners to differentiate them and justify their choices. Ask learners how to avoid ambiguity. Demonstrate possible solutions, e.g. keeping sentences short, using words consistently throughout and placing all adjectives close to the words they modify.

  o Considering the use of the best way to include quantitative data, e.g. visually as pie charts, bar charts or line graphs rather than as a table or a dense paragraph of text. The best way to demonstrate this is to give learners a detailed (i.e. 'wordy') written extract to present and then simply replace this with a chart that illustrates the intended points or comparisons much more clearly and concisely.

  o Discuss how documentation should be recorded, the difference between informal and formal reporting techniques.

  o Demonstrate how visual aids may be used to enhance presentation use, e.g. test captures, animations, led-pointers and pre-prepared handouts.

  o Differentiate for learners the communication requirements of one-to-one and group-based presentations in both informal and formal situations. Draw on learners' personal experiences to identify occasions where they have faced similar challenges and how they managed them. Suggest possible improvements they could make and consider how this could affect the outcome.

  o Ask learners to identify the tone and language used in two sample feedback extracts, one that uses a positive tone and the other that engages in negative rhetoric. Remember to pepper one sample with unnecessary jargons for learners to identify and recommend suitable alternatives for different audience types.

- o Challenge learners to give peers the feedback on their work in session, teasing out the need to be supportive, constructive and managing the tone of the conversation.
- This learning topic should take approximately three hours.
- Review the learner topic using directed question and answer techniques during a suitable plenary.

## Learning aim C2 – Test plan improvements

You will present how test plan improvements are discussed with the development team and detail the possible resulting jobs.

- Using a suitable software development project/case study:
  - o Demonstrate that undocumented bugs will generate new test cases that need to be resolved.
  - o Show how learners can prepare for regression testing, adding new test cases to the test suite based on the newly documented bugs.
  - o Explain how testing feedback should be fed back to the development team, focusing on test results (passed, failed and skipped), format of findings and communication skills.
- Ask learners to work in small groups to review their case study's test results, identify new test cases and add them to a test suite and feed back to their peers. An alternative approach might be to ask groups to review actual software development projects created by other groups of learners and use this for the testing and feedback phase.
- Learners should individually produce a clear and cohesive analysis and evaluation of their plans. Learners should be made aware, via a whole class activity, of the requirements of this. As a class analyse and evaluate a set test plan – ensure learners are aware that this is simply not description and suggestion – the plan needs to be fully evaluated – what are its strengths and weaknesses, how could it be improved etc.
- You should now reissue the skills and behaviours audit completed by learners in the first session so that they can now revisit the document and make additional observations about where and how they feel they have improved. Learners may also find it useful to reference their ILPs when completing this task.
- This learning topic should take approximately five hours.
- Review the learner topic using directed question and answer techniques during a suitable plenary.
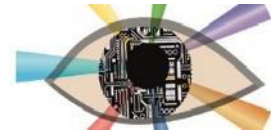
# Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Depending on the choice of project, the following units will provide useful underpinning knowledge and skills that can be drawn on to create the deliverables:

- Unit 4: Programming
- Unit 6: Website Development
- Unit 7: Mobile Apps Development
- Unit 8: Computer Games Development
- Unit 15: Customising and Integrating Applications
- Unit 19: The Internet of Things

# Resources

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

### Textbooks

Hambling B (ed.), Samaroo A, Morgan P, Thompson G and Williams P, *Software Testing: An ISTQB-BCS Certified Tester Foundation Guide* (Third Edition), BCS Learning & Development Limited, 2015 ISBN 9781780172996

Kaner C, Bach J and Pettichord B, *Lessons Learned in Software Testing*, Wiley, 2001 ISBN 9780471081128

Patton R, *Software Testing* (Second Edition), Sams, 2005 ISBN 9780672327988

Whittaker J A, Arbon J and Carollo J, *How Google Tests Software*, Addison Wesley, 2012, ISBN 9780321803023

### Journals

*Journal of Software Engineering Research and Development* – https://jserd.springeropen.com/

*Test Magazine* – http://www.testingmagazine.com/

### Videos

Popular videos – acceptance testing (https://www.youtube.com/watch?v=rj4q7F2DgJ0&list=PLvGFpz7ufL_4LJySYXgaObJnQPNVUzprW)

Manual Testing Training – What is Test Case – Example (https://www.youtube.com/watch?v=mjB9XTpQmgc)

Selenium IDE Demo – Quick Beginner's Tutorial (https://www.youtube.com/watch?v=gsHyDIyA3dg)

How to write a Test Case (https://www.youtube.com/watch?v=BBmA5Qp6Ghk)

Testing a RESTful Web Service with SOAP UI (https://www.youtube.com/watch?v=7YpJS--BqiI)

What is Software Testing & Why Testing is Important? (https://www.youtube.com/watch?v=TDynSmrzpXw)

Introduction to Scrum – 7 minutes (https://www.youtube.com/watch?v=9TycLR0TqFA)

**Websites**

https://www.associationforsoftwaretesting.org/ – Association for Software Testing

www.cwjobs.co.uk – CWJOBS

www.seleniumhq.org – SeleniumHQ – A specialist IT recruitment website

www.tutorialspoint.com – tutorialspoint – Web browser automation tools used for testing via scripting

www.testiatarantula.com – Tarantula test management – Online programming and testing tutorials and resources

www.thetechpartnership.com/– The Tech Partnership – An open source tool for managing software testing in agile software projects

https://www.thetechpartnership.com/tech-future-careers/what-is-it-like/job-roles/– Job Roles – A network of employers working to create skills for the UK's digital economy

*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.*
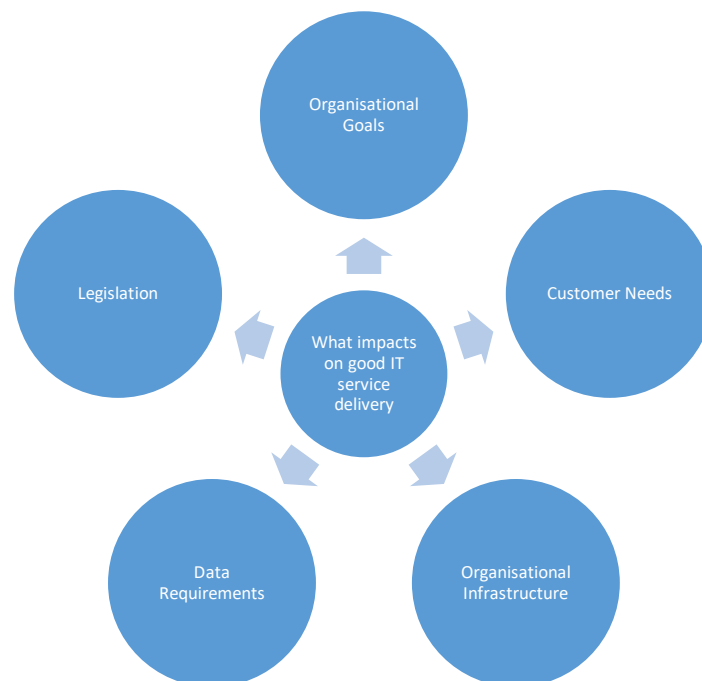
# Unit 14: IT Service Delivery

## Delivery guidance

### Approaching the unit

This mandatory, externally assessed unit on the Extended Diploma program focuses on the processes and contexts of IT service delivery.

The learners will study the types of IT services needed for different organisations, the service catalogue, the service life cycle and how the needs of organisations impact on how an IT service is developed, maintained and reviewed. Assessment will take place with learners outlining an effective IT service strategy and catalogue, designing an IT service solution and preparing management reports on the solution and its implications.

IT service relies on excellent IT service delivery which, in turn, relies on providing and maintaining consistent source of information to support business functions and customers via the service catalogue. These core services available to the business support business processes that enable organisations to meet their goals.

It would be a natural conclusion to study this unit towards the end of the programme due to its synoptic nature and the clear need for learners to be able to apply skills and knowledge learned in other units.

Completion of this unit will prepare learners to work in IT support and enable them to contribute positively to service delivery with ideas and suggestions.

## Delivering the topics

With a wide range of vocabulary being introduced for the first time, the learners could also be asked to contribute to a class glossary of terms including key terms such as service catalogue, business value, organisational goals, supply chain, organisational structures, scalability, asset management and utilisation. The new concept of 'service delivery' must be introduced to learners – tutors may want to utilise the useful 'menu' analogy to communicate what service delivery is. The unit has strong links to most other units simply because IT is used in every organisational context as a service and therefore it touches every part of the organisation regardless of size, type or operational sector.

### Topic A

This topic focuses on the factors that drive the IT service needs of organisations and should be approached by dipping into as many different contexts as possible.

Learners explore the IT service life cycle and tutors should link the life cycle to the more familiar service lifecycle methodologies such as ITIL.

This is another opportunity to reinforce the importance of process in all things in IT in order to ensure that control, compliance and business continuity are maintained at all times.

Learners will be introduced to different types of organisations to ensure that they understand that the profile of the organisation (size, type, sector etc.) impacts on the decisions made in relation to the IT service needed for the organisation to function. They consider the needs of the micro/small business as well as the national company with many offices/premises.

They should also understand the functional activities of these organisations and be able to keep this in mind when designing IT service solutions (for example, manufacturing systems or supply chain management might not be relevant to all organisations).

To complete the topic, the learners consider how services needs are identified by exploring different organisations in more detail. They will consider the wider landscape in which the organisation operates and will examine the expectations of users and customers, moral and ethical considerations and the need to comply with current and relevant legislation in the design and use of IT services.

Deliverable work for this includes an outline IT service strategy, IT service catalogue, a design for an IT service delivery solution, a management report evaluating the solution and an IT service management implications report. More information on these can be found in the Sample Assessment Materials on the Pearson qualifications website.

### Topic B

This topic is split into four parts in which learners are expected to design a service delivery solution by applying their understanding of IT service delivery requirements of organisations in context.

Beginning with a definition of the IT service requirements (including a description of what needs to be achieved, the available data and available technologies) learners then focus on what needs to be considered in terms of constraints (such as cost, ethical, legal etc) to develop an understanding that all developments have boundaries within which they must be developed, weighing up the costs of these choices against the perceived benefits.

They will practice designing IT solutions and advising clients on their recommendations, ensuring that they can justify their choices in the context of the organisation and the issue or problem being resolved.

The topic completes with learners exploring a range of implications in different contexts.
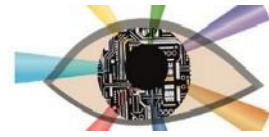
For example, how should data and information be disseminated and how this influences the design of the IT service delivery solution, how the choice of hardware and software impacts on the design of the IT service, and how security, asset management, training and customer support (for example) influence the design and are themselves then affected by it.

## Topic C

This topic focuses on management reporting in relation to the data and information requirements of organisations. It explores how data generated in one functional area can provide information for another function within the organisation.

Learners will consider the different information requirements at operational, management (also called tactical) and strategic levels.

They will gain an understanding of how data is used to manage day-to-day tasks, scope customer needs, ensure that there will be a continuity in the provision of the service or the product and consider how improvements should be planned and communicated with staff and customers alike (mainly to manage expectations).

Learners examine the interrelationship between information and data and how these are generated, including an investigation into data sources and how the volumes of data, velocity (or speed of generation) and the variety (how a mixture of data may need to be processed in order to provide information) will influence decisions about the software and hardware used to deliver the IT service.

## Topic D

The final outcome in this unit examines the software and hardware decisions that need to be made to facilitate activities within the organisation, as well as reporting on the implications of service management. For example, choices made to enable communication, collaboration, data storage, productivity, remote access, creativity (including collaborative software for simultaneous multi-user situations) and customer access options.

The contributions to these processes made by the choice of operating systems, utilities available, applications used and whether they are open-source or proprietary are examined. Although not listed explicitly in this unit, learners should understand the potential dangers of using downloaded software without appropriate checks.

Hardware service options are considered including the use of both typical infrastructure components and devices that can be connected to provide wider access.

Organisational factors such as the size of the organisation, geographical spread (relevant to some of the organisational outlines provided), the potential for the use of emerging technologies (with notes of caution for an early adoption of technology that might not have been tried and tested), and general factors such as user expectations, security, budget, efficiency and scalability complete the study of hardware service options.

The final element of topic D considers how an IT service should be managed, including the introduction of acceptable use policies, an investigation into the pros and cons of using in-house over external systems and for the provision of services which can generate issues of legal ownership of data and jurisdiction (with an opportunity to introduce global and more local EU implications and problems encountered for data storage and processing).

### The approach to this unit should be:

- As practically as possible giving learners an opportunity to explore different contexts for IT service delivery is essential to prepare them for both the assessment and for entry into the sector.

- BTEC Level 3 IT/Computing qualifications have existed for approximately 30 years and it is likely that you will have an alumnus of previous learners who are now practitioners or managers in the sector. You may be able to persuade some of your alumni to provide the employer input.

## Assessment guidance

As an externally assessed unit, Pearson will provide a set task which must be completed under supervised conditions and observing the timings set.

Learners are expected to complete this set task over a period of eleven hours, split over a number of sessions occurring in a five week period timetabled by Pearson. The task has two separate parts - Part A taking three hours and Part B using the remaining eight hours of the allotted time.

Both tasks should be completed in strict order with Part A being completed in a two-week period before Part B.

The set task will assess learners' ability to analyse an organisation's aims and IT service needs.

They will design an IT service solution by applying the IT service life cycle, while considering alternatives and the service management implications these may have on the needs of the organisation.

The number of marks for the unit is 68. The mark scheme will remain the same for each examination series.

The availability of the task is December/January and May/June each year. The first assessment availability is May/June 2018.

Sample assessment materials will be available to help centres prepare learners for assessment.

The examination tasks in the SAMs will not change, only the scenarios utilised, meaning that learners can practise each of the required topics above. You can help to fully prepare learners by creating micro-tasks which duplicate elements of the task provided through Pearson's sample materials, working through these with learners in an interactive and mentoring fashion. Draw out from learners their technical understanding, assumptions and exactly how they are interpreting the task; many marks are often lost due to misinterpretation and misunderstanding.
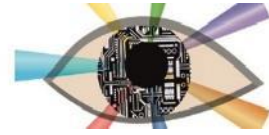
A Level 3 Pass will depend on learners being able to recall and apply knowledge of IT service needs in a range of familiar vocational and organisational contexts. They will use their knowledge of IT to solve problems, breaking down problems into their component parts and applying standard conventions to develop appropriate solutions. Learners should be able to identify how IT can be used effectively, but also to highlight the ineffective use of technology in a range of situations and they should be able to recommend how IT service delivery can be used to meet the operational needs and priorities of organisation.

At distinction, learners should be able to manage more complex contexts and analyse complex information, data, situations and draw conclusions making valid observations on how IT systems are used to meet the needs of different organisations.

They will synthesise the knowledge of IT service delivery, breaking down complex problems and drawing on various sources of information (including significant learning in other units) to develop or suggest effective IT service delivery solutions based on justified priorities, demonstrating an understanding of the implications that this has on both individuals and organisations. They should be able to evaluate the effectiveness of services and systems and make justified recommendations on developments and future actions.

# Getting started

**This provides you with a starting place for one way of delivering the unit. Activities are provided in preparation for the external assessment.**

| Unit 14: IT Service Delivery |
|---|

**Introduction**

Ask learners to share their own experiences of using IT services in a range of contexts (for example at your centre, at home, out and about using mobile devices).

Give learners in groups a type of IT service to research and present back to the class on their findings – this will lead to a more learner driven approach to introducing the topic.

Introduce the concepts of Information Technology Infrastructure Library (ITIL) and explain its importance in managing the IT service delivery process.

NB: Four organisational outlines (case studies) have been provided at the end of the scheme of work for this unit. Tutors should feel free to enhance these – they are merely a starting point.

**Topic A – Contextual factors driving IT needs and services in organisations**

**Topic A1 – IT service life cycle**

● Investigate how IT service failure can impact on organisations, particularly damaging brand through poor customer experience, using recent examples. Explore the IT service lifecycle and its role in managing the IT service delivery processes and experiences for users.

● Understanding the range of roles involved in providing the components of the IT service lifecycle (such as architects, developers etc) will help learners understand the complexity of activity needed to make an IT service the best that it can be.

● Investigate IT service delivery design considering strategy, prioritisation and how this culminates in an IT service catalogue.

● Learners should explore how IT service delivery is impacted by organisational culture, how employees engage with the service and the quality of the service itself. Learners should consider different challenges faced by real organisations using case studies and should spend time sharing their ideas with others.

● Guest speakers from a technical and user perspective will help to make this topic much more interactive.

**Topic A2 – Purpose and functions of organisations**

● Explain organisational contexts including formation of organisations such as sole traders, partnerships, companies, charities and franchises and the range of contexts in which these operate including primary, secondary and tertiary. These should be punctuated with examples such as construction, hospitality, science and innovation, and learners should be clear about the difference between products and services.

● Learners should choose three or four organisations that they can further examine so that they can demonstrate an understanding of the key activities that would be undertaken by that organisation to support its activities (such as the use of scheduling in transport and logistics, or software for data handling in a marketing context).

● Explain the concept of business criticalness and operational support and why understanding priority in these areas is essential in the development of IT services.
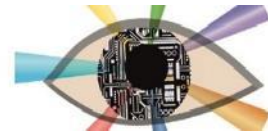
- Complete the topic with learners freely exploring a range of contexts and how IT is used to support the activities (for example, managing staff using HR and training systems, customer relations using CRMs and dialler systems such as Ultracoms).

### Topic A3 – Service identification

- Learners should begin with by revisiting the key areas of an organisation such as purpose, aims and goals, location, customer experience and staffing.

- Using case studies, learners should scope out the IT service requirements of the organisations in the context of the study and in relation to the key areas covered.

- Reinforcing previous learning in Programming, IT project management or Data modelling, learners must practise developing diagrams that can be used to represent and articulate the IT service being designed. There are many examples of diagrams on the internet that can be used as exemplars and links to some of these have been provided in the scheme of learning.

- Explore some of the external factors that can affect IT service delivery such as legal, moral and ethical issues, considering issues such as censorship and privacy. There will be ongoing news articles on this subject and whilst some have been provided more recent examples should be sought.

- Why do organisations create and implement acceptable use policies? It is likely that the learners will have signed the centre's policy at the start of the course. This could be used as a discussion point - each point could be discussed and learners should be asked to comment on the appropriateness of the point and the way it is applied. They should also consider why it is necessary to use such policies.

- Explore legislation in context with learners suggesting the regulations that would be relevant in a range of situations.

- A guest speaker who could present security in relation to IT service delivery as a masterclass would give learners an opportunity to ask questions to clarify their understanding of this highly important area.

### Topic B – IT service delivery design

### Topic B1 – Defining IT service delivery requirements

- Employers should be invited to run a workshop. They should be asked to provide an example of a service delivery problem that they should invite learners to explore and resolve. In the event that an employer is not available case studies should be used. Clearly a real employer would be preferable.

- If an employer is available the learners should be able to interview him/her as a part of the workshop to clarify understanding. If using a case study the tutor should act in this regard.

- Depending on which route is undertaken, the learners will define the requirements for a potential solution and produce an IT service catalogue.

- Presenting this to the 'client' is essential before the actual solution is revealed.

### Topic B2 – Considerations when defining IT service delivery requirements

- Explore the benefits and constraints of different factors on the development of IT service delivery. This is likely to be similar to most projects.

- Relate this to a case study and produce a presentation that will share the benefits and constraints with a real or a pretend client.

### Topic B3 – Designing an IT solution

- Learners use a case study and design a solution focussing on information and data

requirements, hardware and software options and recommendations on how the infrastructure and users should be managed.

● The design should be presented to a real or a pretend client.

## Topic B4 – Considerations when designing an IT service delivery solution

● Learners should evaluate their solution from the previous outcome in terms of how well they think it has met the needs of the organisation.

● Further explore the implications in relation to how the data and information is disseminated across the organisation (for example security - inappropriate/ insecure storage or transmission could breach the terms of the DPA).

● Set learners a task that requires them to disseminate information with restrictions (in other words setting constraints on what they can and cannot do in relation to the user audience). Learners may consider using a range of communication tools (in line with the restrictions in the task).

● Learners create a checklist that should be used by developers in designing and developing IT service delivery to ensure that requirements are within boundaries.

● Topic B4 focuses on how service delivery impacts on a range of factors and learners should be able to demonstrate understanding by giving examples in each category such as asset management, asset utilisation, management updates, installation and/or deployment, security, legislation, ethical and moral issues, staff training and strategy for support and identifying challenges faced by organisations when managing a change. Some examples have already been provided but this should be expanded through learner activity.
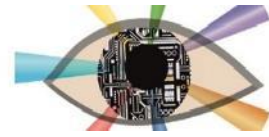
## Topic C – Information and data requirements of organisations

## Topic C1 – Information in an organisation

● Explain data and information and context. For example, prices and quantities are data as they make invoice information. The invoice information is the data that provides management information on sales.

● Discuss different information items and explore why some information should only be disseminated to specific levels of the organisation (as suggested in the scheme of work redundancy and redeployment are good topics for discussion as these can be destabilising and demoralising for employees, and can result in good employees unnecessarily jumping ship early in fear for their jobs). Why should only certain functions within an organisation have access to HR and payroll information (such as the attachment of earnings orders for parental contributions etc)?

● A guest speaker should be invited, particularly the MIS manager at the centre, who can talk about types of information that the centre needs to function, types of information that is produced by the activities of the organisation and which external organisations would be users of that information.

● Explore stakeholders and the range of stakeholders most organisations have. Learners should be able to explain a range of internal and external stakeholders for the centre and should be able to extrapolate this to a range of organisations in different contexts and they should be able to identify different types of information that these stakeholders would require from the organisation.

## Topic C2 – Data in an organisation

● Test learners' understanding of data and information in context before further exploring the concept of data.

● Learners should use case study examples to identify the types of data the organisation is likely to generate and how it might be used. They should be able to

identify data used for management decision making, data used operationally and data used for strategic planning.

- Focusing on the case study for Gordon's Gym and Swim (provided in the Scheme of Work) learners should examine the data generation and data requirements for the organisation. Still using the same scenario learners should be able to identify which data should be shared across which levels or functional areas of the organisation. Learners should present their study outcomes to a panel.

## Topic D – Facilitating IT service delivery

### Topic D1 – Software service options

- Learners identify as many types of software services as they can (focussing on the operational tasks such as collaboration, productivity and remote access) before naming specific software applications that support this activity.

- Explain proprietary and open-source software, highlighting the possible dangers and security implications related to downloading software from insecure sources. Learners should be able to examine a range of software and comment on a range of factors such as functional elements, performance, stability and scalability.

- Explore the classroom PC. What is loaded in terms of software services – what do these services do? Learners make a list (or produce a table) stating the software and the service it provides.

- Learners create a questionnaire and carry out live interviews with two people working in the sector in IT service roles to capture information about the features of operating systems, utility software, applications etc that they use to provide a service to users.

### Topic D2 – Hardware service options

- Learners would benefit from a tour of the centre's IT facilities such as server rooms, IT support help desk and maintenance stations. They should observe surveillance and security hardware and technologies inside and outside the building, cable junctions and wireless access points. Learners should make notes about what they have seen and where.

- Using a building/floor plan of the centre learners should annotate what they have seen and where (this links back to earlier activity in this unit on diagramming).

- Explore a range of hardware used to underpin the IT service.

### Topic D3 – Managing IT service delivery solutions and the implications of change

- Learners make recommendations to Gordon's Gym and Swim about how change should be managed.

- Learners develop and present a comprehensive plan for Gordon's Gym and Swim about how the improved IT service delivery should be managed, such as how customers and/or users will be managed and supported, how assets will be managed and how incidents will be managed.

- Review the centre's acceptable use policy that they signed – go through it point by point so that learners can understand the reason why each point is present.

- To complete the learning for the unit, learners should develop an appreciation of in-house versus external IT service – in particular considering issues such as cost, availability, scalability and the more serious aspects of legal ownership and jurisdiction when data is stored, managed and processed in different locations in the world (as different countries have different rules and regulations about how data is protected and used).

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

Depending on the choice of project, the following units will provide useful underpinning knowledge and skills that can be drawn on to create the deliverables:

- Unit 1: Information Technology Systems
- Unit 2: Creating Systems to Manage Information
- Unit 3: Using Social Media in Business
- Unit 4: Programming
- Unit 5: Data Modelling
- Unit 6: Website Development
- Unit 7: Mobile Apps Development
- Unit 8: Computer Games Development
- Unit 9: IT Project Management
- Unit 10: Big Data and Business Analytics
- Unit 11: Cyber Security and Incident Management
- Unit 12: IT Technical Support and Management
- Unit 13: Software Testing
- Unit 15: Customising and Integrating Applications
- Unit 16: Cloud Storage and Collaboration Tools
- Unit 19: The Internet of Things
- Unit 20: Enterprise in IT
- Unit 21: Business Process Modelling Tools.

## Resources

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

### Textbooks

Brewster E, Griffiths R, Lawes A and Sansbury J, *IT Service Management* (Third edition), BCS, 2016 ISBN 9781780173184 – This publication is available in both Kindle and printed editions. It is equally useful for those who are seeking to undertake ITSM qualifications and those working in the sector who want to develop their service management understanding and skills.

Poppleton A and Holmes K, *IT Service Management for Small IT Teams*, BSI British Standards Institution, 2011 ISBN 9780580742545 – This book is a good supporting text for this unit as it summarises many of the key learning points. Learners will be left in no doubt why organisations that want to be successful should develop and implement an IT service delivery strategy which really has explored all of the contextual factors that the organisation, its staff and its customers operate in.

Wheatcroft P, *Service Desk and Incident Manager: Careers in IT Service Management (BCS Guides to IT Roles),* BCS*,* 2014 ISBN 9781780172330 - This publication is available in both Kindle and printed editions. This is a useful reference guide for IT service related jobs in the sector providing an appropriate rationale for the roles in an organisational context.

**Journals**

http://www.computerweekly.com/

This is a collection of published articles on a variety of technical subjects separated into three key areas such as IT management, industry sectors and general technology topics.

http://www.computerworld.com/

Collection of news articles across this sector.

**Videos**

Improving Performance in IT Service Delivery (10 minutes) – an overview of why IT service delivery should never stand still (https://www.youtube.com/watch?v=wEYCVCBVqSs)

What is ITIL? (5 minutes – start at 1 minute 17 and stop at 3 minutes) – very basic introduction to the ITIL framework (useful at the start of the unit) (https://www.youtube.com/watch?v=M9_0_BkqwzM)

ITSM Change Management Best Practices (55 minutes) – this is a lengthy video but is good for highlighting best practices. Tutors might find it beneficial to watch the full video and write down some key start and stop times that could be shared with learners either in class or for homework (https://www.youtube.com/watch?v=LyIdHTn-kuY).

ITIL Fundamentals (17.5 minutes) – a video that explains what the ITIL framework is all about (https://www.youtube.com/watch?v=ogmkX_E1c1M&t=63s)

**Websites**

http://www.gre.ac.uk/it-and-library/about/policies-and-procedures/it-policies/computer-related-legislation – computer-related legislation – regulation by regulation overview of what individuals and organisations must do or not do. However, this website does not cover all of the regulations in the list.

http://www.bath.ac.uk/bucs/aboutbucs/policies-guidelines/A.Guide_to_legislation_relevant_to_the_Information_Systems_Security_Policy.pdf – a guide to legislation relevant to the Information Systems Security Policy – slightly less user friendly than the previous link, but is more comprehensive.

http://users.ox.ac.uk/~tony/itilv3.ppt – key concepts of service delivery and management based on ITIL principles

http://www.legislation.gov.uk/ – legislation – a comprehensive site for all things legislative. Its main advantage is that as a government website any updates to the legislation will also be available.

*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.*

# Unit 15: Customising and Integrating Applications

## Delivery guidance

In business situations there will be times when a problem does not require a bespoke programmed solution because a solution could be achieved through creating customised or integrated systems using existing packages such as Microsoft Access or Excel and using VBA to provide a customised user interface that uses the functionality of the packages in a new way.

The main advantage of using existing software and its associated data files is that there is no need to migrate data from one system to another which can be expensive and time-consuming to achieve – the functionality of the software can be used as normal. For example,
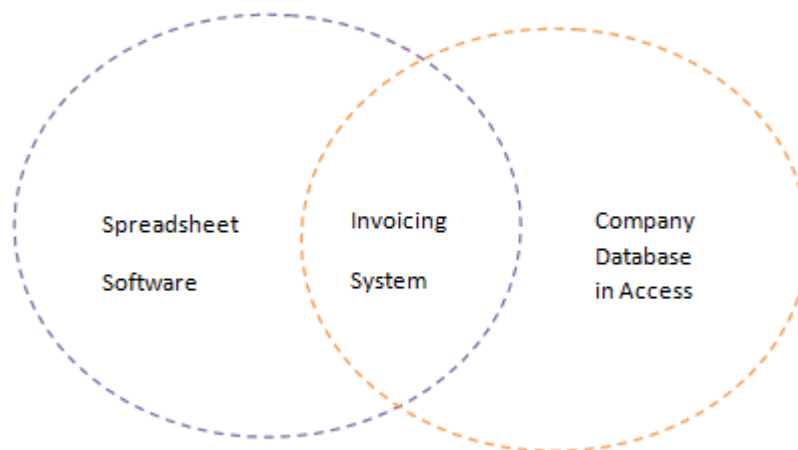


Databases have limited mathematical and analytical capabilities and spreadsheets have limited data storage functionality. Creating a 'front end' using a programming language could produce an interface that allows the user to produce customer invoices using data held in the company database, via the spreadsheet software.

This makes customising a less expensive alternative to designing and programming whole new solutions.

Customisation at its simplest level could include using functionality such as paste link to create spreadsheets that are updated on open. At its most complex form, it could be a Customer Relationship Management (CRM) system that manages the data belonging to a group of companies owned by the same parent organisation.

In this unit, learners will explore customisation and integration using a range of tools and techniques. As there is a programming element, this unit would benefit from being taught alongside or following Unit 4: *Programming*.

## Approaching the unit

This unit should be taught practically and this is an opportunity to involve employers, particularly small businesses, who could provide scenarios and case studies for learners to tackle.

## Delivering the learning aims

### Learning aim A

While it is likely that most learners will have a relatively good understanding of different types of application software, they might not appreciate that office, Internet, security and cloud software will often need to be used together to provide a working solution to a problem.

You should begin with a recap of the different types of software and learners should be able to give examples of software for each category.

It is essential that they understand the difference between customising and integration and learners should be able to write a definition that correctly distinguishes them as approaches.

There are many potential issues with integrating applications (in particular) and learners will investigate some of the common problems from data consistency and formatting to communication protocols and issues of permissions and file sharing.

The aim completes with learners investigating how programming languages are used to integrate applications. Learners should consider a range of languages and should be able to demonstrate the ability to choose the right language for a particular situation.

Customisation can be achieved within a single application, such as adding automated routines to a spreadsheet or adding a menu to database software.

The final topic allows learners to develop an appreciation of how the integration of applications can be used to develop a range of solutions.

### Learning aim B

This learning aim is practical and should begin with learners exploring the IDEs they will be using in their integration activities. You will need to produce some exercises relevant to the combination of software you have at your centre to enable the learners to practise some of the techniques they will use in their assessment. Online examples are available such as copying data from MS Access to MS Excel using Python or using Python to read an Excel file.

Learners would also benefit from using the Internet to search for websites, development forums and technical threads which will provide a useful resource to support them in their problem solving.

Testing and debugging are key to developing business solutions and while learners will have met this content before, it is unlikely that they will have designed testing strategies that will incorporate a number of different (and possibly diverse) applications or scripts working together in this way. Debugging also is essential, particularly to resolve any semantic (as opposed to running) errors.

**Learning aim C**

Applications are customised and/or integrated to solve a business need. This is usually to meet an organisational need which could be as simple as exploiting capabilities to enhance efficiency or it could be to improve responsiveness in an enterprise context.

Learners should therefore explore a range of scenarios where integration and/or customisation would be a factor. For example,

- An automated raw materials ordering system for a manufacturing company by integrating stock control, finance and manufacturing planning.

- An environmental management system for a suite of residential building that is designed to promote energy efficiency.

- An inventory tracking system across multiple domestic appliance stores.

- A case management and problem escalation system for social workers who work out in the field.

- Absence reporting and holiday request system for a business with analytic capabilities.

- A system for tracking resources used on multiple simultaneous projects (such as man hours and other direct and indirect costs), which generates customer invoices.

- A marketing system for managing and scheduling digital marketing activity for a group of clients.

- A system for a company involved in preparing international payroll.

- An online newsfeed site that draws articles from other websites based on a user's choices.

- A secure file sharing system for a scientific collaboration.

Customisation could include:

- A series of linked spreadsheet pages managed through a customised menu using form with buttons to control access and updating to the contents and data.

Developing customised and integrated applications follows similar processes to other IT projects in that user requirements must be defined (which is often the identification and articulation of the business need), success criteria must be established, the user interface requirements agreed and any project constraints should be identified.

Learners design a proposed solution, using traditional design tools, techniques and methods, designing test plans and test data and creating a prototype (or prototypes if applicable), as part of the design process.

The design will need to be refined, gathering feedback from others to inform changes, and documentation will need to be updated to reflect any changes or improvements to the proposed design.

Learners develop a customised and integrated solution in line with the proposed design, debugging and fixing problems as they arise to create a final version of the solution.

Functional testing is executed in line with the test plan and the solution is then compared against the user requirements to establish how well it meets the user's requirements, functions as expected and meets quality, reliability, usability and performance expectations.

**The approach to this unit should be:**

- As practical as possible to give learners an opportunity to develop a range of customisation and integration skills.

- Business scenarios should provide a context for activity.

- BTEC Level 3 IT/Computing qualifications have existed for approximately 30 years and it is likely that you will have an alumnus of previous learners who are now practitioners or managers in the sector. You may be able to persuade some of your alumni to provide the employer input.

## Assessment model (in internally assessed units)

| Learning aim | Key content areas | Recommended assessment approach |
|---|---|---|
| **A** Investigate the customisation and integration of applications used by organisations to meet their needs | **A1** Types of application software<br><br>**A2** Purpose of and issues with customising and integrating applications<br><br>**A3** Software customisation and integration | A detailed presentation or report evaluating the customisation and integration of applications. |
| **B** Explore the technologies and techniques used to customise and integrate applications | **B1** Integrated development environments (IDEs)<br><br>**B2** Programming constructs and techniques for customising and integrating applications<br><br>**B3** Testing customised and integrated applications | A practical activity to develop short prototype software solutions that demonstrate the integration and customisation of different software applications.<br><br>A report focusing on what went well and what did not go so well when customising and integrating software applications using different technologies. |
| **C** Develop customised and integrated applications to meet organisational needs | **C1** Design for customised and integrated applications<br><br>**C2** Develop customised and integrated applications<br><br>**C3** Testing customised and integrated applications | A practical activity involving defining the specification for the problem, designing and developing fully working customised and integrated software applications to meet a client's needs. |

## Assessment guidance

The assessment for this internally assessed unit would benefit from being divided into three assignments as shown above.

### Assignment 1 (learning aim A)

A detailed presentation or report evaluating the customisation and integration of applications.

Learners create a slide show with supporting notes which they present to an audience. You will need to provide a realistic scenario for them to use as the basis for their presentation which should explain why integration and customisation is appropriate as a possible solution to the business problem identified in the scenario.

What is the difference between the two approaches? How can each be used in the context of the scenario?

Learners should be able to explain any potential issues that might need to be managed.

Learners should ensure that the presentation is suitable for the audience as defined in the scenario they are given.

As an idea, the tutor could prepare two or three different scenarios that would make watching the presentations more interesting and give learners an exposure to a wider range of situations.

You may choose to link this assessment to either assignment 2 or assignment 3.

## Assignment 2 (learning aim B)

The assignment requires a practical activity to develop at least three short prototype software solutions that demonstrate the integration and customisation of different software applications. Learners will produce an accompanying report that discusses the prototypes and how customisation and integration have been used. The report will also focus on what went well and what did not go so well when customising and integrating software applications using different technologies.

As all learners will essentially be producing the same answers, you might consider the addition of a viva to enable you to be confident about the skills and abilities of individual learners. This does not need to be extensive and cover all of the grading criteria/assignment content, but you might find this useful to support your decisions.

## Assignment 3 (learning aim C):

A larger project to the short prototype software solutions in assignment 2, this assignment will be a practical activity involving defining the specification for the problem, designing and developing fully working customised and integrated software applications to meet a client's needs.

You have the option for this assignment to link the activity to the scenario (or scenarios) used in assignment 1.

# Getting started

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

| Unit 15: Customising and Integrating Applications |
|---|
| **Introduction** |
| Ask learners to share their own experiences of using integrated systems. Can they give examples? |
| Can they name any applications they have customised – with automation, the integration and use of an API to customise the user experience by providing additional functionality? |
| Pose the questions: |
| Why off-the-shelf applications do not meet business needs? |
| Why should businesses develop an application integration strategy? |
| Consider showing the short video to help answer the last question (see the link in the resources section at the end of this delivery guide). |
| **Learning aim A – Investigate the customisation and integration of applications used by organisations to meet their needs** |
| **Learning aim A1 – Types of application software** |
| <ul><li>Begin with a Q&A. How many different types of application software categories can learners identify.</li><li>Learners should then name software products in each category.</li><li>Carry out a straw poll – how many learners can say that they have used at least one product in each category?</li><li>Learners carry out group work (or paired work) to investigate less well-known examples of products in the different categories. You could include the following or provide other examples:<ul><li>Office products could include: Calligra Suite</li><li>Web browsers could include: Maxthon, Lunascape Orion, Citrio and Midori</li><li>Security could include: Glasswire and Avira</li><li>Cloud software could include: Hitman Pro, Glasswire and RKill</li></ul></li><li>Learners could experiment by trying out the web browsers and comparing the functionality, response etc to the browsers they currently use like Google and Edge.</li><li>This activity could result in a presentation to other learners who share their research and observations.</li></ul> |
| **Learning aim A2 – Purpose of and issues with customising and integrating applications** |
| **Difference in approaches between customising and integrating applications:** |
| <ul><li>Presentation focusing on the difference between customisation and integration of applications. It should begin with a definition of each term and be supported by examples in each case. There are a number of examples in the specification that will help to inform the presentation.</li></ul> |

**Purpose of customising and integrating applications:**

● Referring back to the introduction, why do businesses customise and integrate applications?

  Learners work in small groups to investigate either the Virgin and Lloyds case studies included in the resources section of this delivery guide (under News articles). What were the reasons for the integration – were these pro-active or reactive activities?

  You should lead a class discussion to explore the what, how and why in each case.

● During the discussion, you should contribute additional reasons why applications are customised or integrated (either from the list in the specification or by giving examples of your own).

**Common issues with data customisation and integration:**

● Presentation on the common issues with data customisation and integration – where are mistakes commonly made?

● Where possible, focus on real examples from personal experience, articles in the news and ask learners to investigate any of the issues listed in the specification such as data integration failures or automation failures (see Sainsbury's example in the resources section).

**Possible solutions to common issues:**

● Learners work in groups or pairs to investigate solutions to application customisation and integration issues. Allocate one of the following to each group or pair and ask learners to investigate:

  o Data security

  o Cloud technology

  o Data compartmentalisation

  o SaaS.

**Learning aim A3 – Software customisation and integration**

**Common programming languages used in customisation and integration:**

● Individual activity where learners explore an allocated programming languages from those in the specification list.

  Create a table that has each language listed, with columns for 'Uses' and 'Comments'. When learners feed back about their language to the class, each learner should populate the grid with the relevant information as supplied by other learners.

**Factors to consider when choosing suitable languages for use in integration and customisation projects:**

● You should lead a discussion on what learners should consider when making a selection. What sort of criteria should they consider? Why? You should also explore why they might consider something less familiar, particularly if the language might provide a better solution.

**How application software can be customised:**

● Define customisation, giving examples for spreadsheets, email software, databases and a web context.

● Create an exercise where learners carry out a simple customisation on a spreadsheet – specifically creating a macro that copies and pastes a value (or set

of values) from one spreadsheet into cells in another spreadsheet.

**How application software can be integrated:**

- Define integration, explaining ERP, EDI etc as listed.

- Learners investigate the benefits of CRM systems (see the link in the resources section), either as pairs or small groups. They should write a 200-word news article that promotes the concept of a CRM and the benefits to business.

## Learning aim B – Explore the technologies and techniques used to customise and integrate applications

### Learning aim B1 – Integrated development environments (IDEs)

- Identify at least three different IDEs for learners to compare. Prepare a checklist for the functions listed in the specification and instruct learners to investigate each IDE and indicate which features or functions each one has.

- Lead class discussion – which of the IDEs offers the greatest flexibility and why?

### Learning aim B2 – Programming constructs and techniques for customising and integrating applications

- Prepare (or acquire) a series of worksheets that will allow learners to develop and practise skills and techniques they will use to customise and integrate applications.

- Learners could use previously written code and make some adaptations, for example introduction of functions, exploring more complex parameter passing, working with different array types, for example an array of records.

- Set up a simple relational two table database (so that a query is involved), and ask learners to use a language to query data and extract the records from the database into another application (or even just into a text file).

- Create a consolidation spreadsheet by linking data between worksheets and spreadsheet files into a master file (an example exercise is included in the resources section at the end of this delivery guide).

- Learners should create simple validation routines in a range of applications.

- Provide a file containing charts and graphs linked to a data set, and then ask learners to modify the parameters and associated text, changing the chart or the graph type as part of this process.

There are many exercises that could be carried out here – and you may be able to use exercises from other courses in your department where they exist or draw examples from programming units that can be adapted.

### Learning aim B3 – Testing customised and integrating applications

**Test customised and integrated applications:**

- Lead a class discussion on testing techniques used so far in other units or assessments. Which apply for testing customised and integrated applications?

- Make a list and ask learners to define each one they understand and investigate any that they do not.

- Learners work in pairs to investigate integration testing. A link has been provided in the resources section of this guide, which will give a good starting point. How does integration testing within a programme or series of linked programmes translate to a scenario with integrated applications? Lead a class discussion.

**Debugging:**

- Learners should practise using debugging techniques. Syntax errors are often easy

to spot. Semantic errors (errors in meaning rather than incorrect code) are less easy to spot.

## Learning aim C – Develop customised and integrated applications to meet organisational needs

### Learning aim C1 – Design for customised and integrated applications

**User requirements:**

● Presentation focusing on user requirements. Discuss the challenges of working with a client to define a problem and the reasons why the problem scope should be recorded once it has been agreed (particularly to help protect against project creep). Why is it important to identify constraints, the user interface requirements and the criteria that will be used to measure success?

● Lead a discussion possible project failure due to errors in establishing user requirements. The scope creep article blames the failure of a project on three key factors. This article will be a good starting point for the discussion.

**Design:**

● Learners should practise designing integrated and customised applications using a range of scenarios. They should use illustrations and diagrams, flow charts to communicate processing stages, control structures and activity diagrams. The scenarios can be relatively simple, and you would benefit from having two scenarios and allocating them equally to different groups in the class. Once a group has completed their design, they should informally present the design to a group working on the other scenario. Any feedback from the observing group should be recorded. The process should then be reversed. Scenarios could include:

  o A customised interface for a group of disabled adults with poor motor skills.

  o Setting up an automated custom filter.

  o Setting up an invoicing system that draws customer data from a database.

● For each scenario worked through, learners should be able to explain their reasons for the design approach taken.

**Review and refinement of the design:**

● Presentation on the role of the review in the design process, posing a series of questions – for example:

  o Why is ongoing communication with the client important?

  o Why should feedback be gathered during the design stage?

  o Why should ideas and proposed solutions be refined?

  o Why should a design specification be constantly updated?

  o Why should the techniques and approach used be reviewed?

### Learning aim C2 – Develop customised and integrating applications

**Using tools and techniques:**

● Using the designs created in learning aim C1, learners use a range of techniques, constructs and languages to create a prototype (this does not need to be a full prototype, but should demonstrate the workings of at least part of the system).

● Carry out a review of the techniques, constructs and languages that learners used and provide feedback. Were these used correctly and efficiently? What could they have done differently?

**Review and refine the solution:**

- Learners should ask for feedback on their product. Do the class feel that the product met the objectives originally set out in the scenario? Are there any enhancements that could be made relatively easily to improve the functionality of the solution?

## Learning aim C3 – Testing customised and integrated applications

**Functional testing:**

- The applications should be subjected to functional testing against an agreed test plan. Results should be recorded. You could consider issuing a testing log that learners could use to record the test, test data, result of the test and any actions that need to be taken (for example correcting errors – what need to be corrected and how was this achieved?).

**Acceptability testing:**

- The concluding part of the testing is essentially checking the final solution against a range of criteria.
  - o Does the solution meet all of the requirements (or does what was created fully meet the requirements it was intending to meet)?
  - o Does it work as expected?
  - o Is it reliable, usable and of good quality?
- Learners create a short presentation that explains the outcomes of the activities – what would they do differently if they did this project again?

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

Depending on the choice of project, the following units will provide useful underpinning knowledge and skills that can be drawn on to create the deliverables:

- Unit 2: Creating Systems to Manage Information

- Unit 4: Programming

- Unit 5: Data Modelling

- Unit 7: Mobile Apps Development

- Unit 9: IT Project Management

- Unit 11: Cyber Security and Incident Management

- Unit 16: Cloud Storage and Collaboration Tools

- Unit 19: The Internet of Things

- Unit 21: Business Process Modelling Tools

# Resources

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

### Textbooks

Mendelsohn E, Monk E, Cook G and Brady J, *Problem Solving Cases in Microsoft Access and Excel* (14th Edition), CENGAGE Learning Custom Publishing, 2016 ISBN 9781305868625 – a highly practical and up-to-date publication that requires learners to use Excel and Access to create solutions to business problems

Woo D and VanHuss SH, *Integrated Computer Applications* (6th Edition), South-Western College Publishing, 2011 ISBN 9781111988098 – This book is now a little dated, but it provides useful exercises and ideas on how applications can be integrated to provide business solutions.

### Videos

Develop an Application Integration Strategy (4.5 minutes) – considers the state of current business IT resources and why strategically planned integration (https://www.youtube.com/watch?v=pSOMPhMCAZ4)

How to use Excel and Access for a solution – this is a YouTube channel with a range of how to videos that show how Excel and Access can work together to produce business solutions (https://www.youtube.com/channel/UCPMn-fP8ruZWhE-soxNUwnA).

What is an API? – Fast Tech Skills (5 minutes) – this short video explains the concept of API and how it allows access to pre-existing services (https://www.youtube.com/watch?v=B9vPoCOP7oY).

What is an API? (3.5 minute) – the second short video which introduces API using different examples (https://www.youtube.com/watch?v=s7wmiS2mSXY).

### Websites

https://dev.office.com/docs – Office Developer Centre – providing coded examples, documentation and resources for developers seeking to customise Microsoft products

https://www.netguru.co/blog/software-testing – Test all the Things! Types and Examples of Software Tests

http://www.preact.co.uk/why-crm/how-businesses-benefit-from-crm – 19 Business Benefits of CRM – 19 reasons why customer relationship management systems benefit organisations with a range of examples

http://web.utk.edu/~dhouston/excel/exer8.pdf – Microsoft Excel Exercises – Linking Exercise (Exercise 8) – creating and consolidating spreadsheets between workbooks and a master file

**News articles:**

http://www.campaignlive.co.uk/article/186004/virgin-relaunches-upper-class-integrated-dm-push# – Virgin relaunches Upper Class with integrated DM push – the integration of data, communication and a microsite to reinvigorate this Virgin product

http://www.computerworld.com/article/2533563/it-project-management/it-s-biggest-project-failures----and-what-we-can-learn-from-them.html?page=3 – Sainsbury's warehouse automation – what went wrong

http://www.information-age.com/merging-lloyds-tsb-and-hboss-applications-2127203/ – Merging Lloyds TSB and HBOS's applications – how the organisation combined its IT applications following merger

http://www.techrepublic.com/blog/tech-of-all-trades/real-world-example-of-scope-creep/ – Real world example of scope creep – an anecdotal example from an IT project manager. The conclusion to this article focuses on poor communication, poor setting of project requirements and a failure to fully assess options.

*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.*

# Unit 16: 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 while providing a lower total cost of ownership.

In this unit, learners 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:
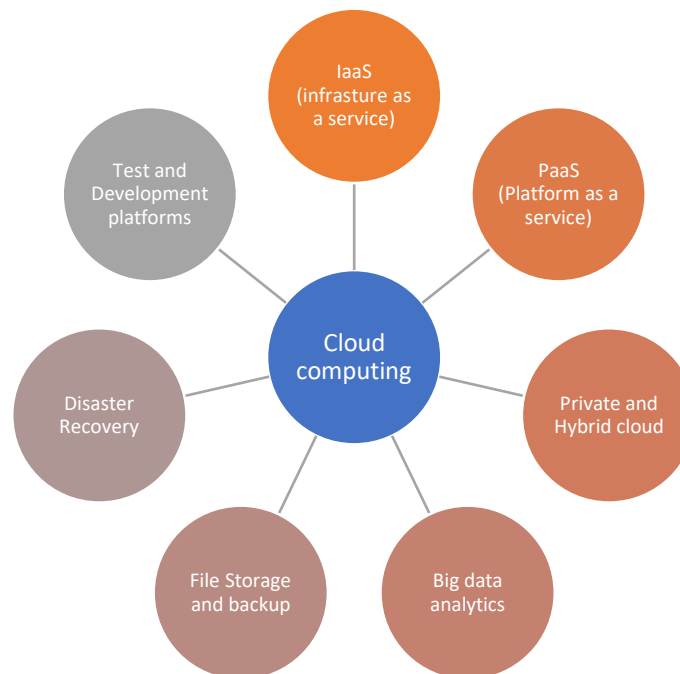


To appreciate these applications and their impact on organisations, learners will develop skills that enable them to:

- 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.

Take opportunities to involve local employers as clients as this will enhance both the project and learner experience.

There are also 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 web application in the cloud.

It would be ideal if the class or course had a social media page, as this is a good way for 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 three-fold approach to learning:

- research-based investigation into digital animations and effects, their respective purposes, impacts and relevant legal requirements

- free form and client brief-led exploration of design ideas for potential digital animations and effects

- practical skills-based and goal-oriented production of digital animations and effects using commercially relevant software and hardware.
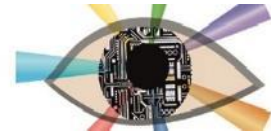
## Delivering the learning aims

### Learning aim A

The first aim focuses on the use of cloud technologies and tools in organisations. Although mainly theoretical in nature, it asks learners to think about the key drivers for organisations' adoption of cloud technologies in preference to more traditional resourcing models. You will need to ensure that learners appreciate the key characteristics of cloud computing. They should be able to identify these, describe them and give the relative benefits and drawbacks of each. Inviting a guest speaker from an organisation that makes use of virtualised and cloud storage technologies to come and talk to learners about the practical decisions involved in making such strategic and operational decisions is an ideal complement to this type of study.

Although it is possible to discuss different cloud computing models from a theoretical perspective and there are many videos, presentations and animations that support this approach, it is better to use available tools such as Google's Compute Engine (for example) to set up a simple IaaS solution or create a smaller PaaS solution using free software such as Vagrant, Docker and Node.js. This is of course, just a recommendation as this unit does not recommend any particular technology. Fortunately, there is a range of commercial and open source resources available, some of which are free.

Investigating the IT requirements of an organisation tends to work best when real-life case studies are involved, particularly if drawn from a local SME where guest speakers may be invited to discuss their experiences. The impact of cloud services are easily researched and can be discussed in purely monetary terms if hardware, software and communication resources are considered. Less tangible but equally important concerns, e.g. staff issues, and legal and ethical constraints often encourage spirited discussion among learners.

Legal requirements have a somewhat undeserved reputation as being notoriously difficult to embed into a learning programme without resorting to tried and tested research-and-present style tasks. Although this is a practical approach, the leveraging of case studies, particularly prominent infringements and settlements covered in the press offer a reasonable alternative for group or round-table discussion. The use of classroom 'courts' with learners role playing the various parts (defendant, prosecution, defence, jury and expert witnesses) and you as the Judge can be particularly effective when paired with the legal frameworks relevant to this subject. Cases where the Data Protection Act 1998, Computer Misuse Act 1990 and the Copyright, Designs and Patents Act 1998 appear to have been breached offer a multitude of discussion points and, often, very lively participation!

## Learning aim B

The second learning aim focuses on the use of cloud technologies and tools in organisations. This learning aim provides a simple sequence for learners to follow: plan, review, refine and develop. Once again, there is a direct benefit if learners are introduced to a real-world scenario which they can follow step-by-step from initial investigation through to final deployment. Naturally, the solution may be artificially narrow and/or contrived in nature (by design) to keep the potential complexity issues appropriate to learners' abilities, but with sufficient support and scaffolding, workable solutions should be possible. Future cohorts can of course benefit from those solutions generated in previous years.

## Learning aim C

The final learning aim focuses on managing and reviewing a cloud-based collaboration service to meet a client's needs. In many respects, it is a continuation of the second learning aim, moving the learner through management and review of cloud-based collaboration solutions.

Presentation skills, which form a key component of this last learning aim, may benefit from being brought forward in the delivery pattern to prepare learners more appropriately. This is particularly significant as 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. Most of these activities benefit from improved communication skills.

## Assessment model (in internally assessed units)

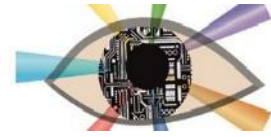| Learning aim | Key content areas | Recommended assessment approach |
|---|---|---|
| **A** Explore the use of cloud technologies and tools in organisations | **A1** Cloud computing in organisations<br><br>**A2** Cloud computing models<br><br>**A3** IT requirements of an organisation<br><br>**A4** Impact of cloud services<br><br>**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<br><br>**B2** Reviewing and refining designs<br><br>**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<br><br>**C2** Reviewing and refining cloud-based collaboration solutions<br><br>**C3** Lessons learned from developing cloud-based collaboration solutions<br><br>**C4** Presentation skills<br><br>**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 as shown above.

### 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 only use organisations that have no or limited adoption of cloud technologies as part of their exploration study. Again, if the organisation is local, there may be increased opportunities for associated activities, e.g. industrial visits and guest speakers.

Things to remember to offer the best opportunity for learner success:

- Learners must use technical language fluently and appropriately in their deliberations.

- Learners need to fully understand the characteristics of different cloud technologies and delivery models and be able to consider the benefits that each would bring to the

organisation and the more negatively-skewed impacts that might affect its customers, staff and services.

- Access to appropriate hardware, software and tutorials may be required to illustrate some required content.

- Learners will need to access a range of both 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 fertile ground for the design and development of cloud storage and collaboration solutions. Where possible, it should include hidden learning that can support progress in other units and afford some inter-curricula links.

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.

Things to remember to offer the best opportunity for learner success:

- Learners should demonstrate evidence of research that is pertinent to the client brief, generating ideas that reflect the needs identified. Learner notes that justify their decisions through a clear understanding of cloud computing models, IT requirements of the organisation and its potential impact should be readily available.

- Designs should be reviewed and revised as necessary, paying particular attention to justifying any decisions (or changes) made.

- The revised designs should be developed using appropriate hardware and software tools. Expect the learner to document each part of creation process, providing a detailed explanation of the tools and techniques used with a rationale for their selection.

- Learners need to test the final cloud-based collaboration service product using a range of appropriate techniques and review how closely they have resolved the client's original requirements.

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

- Access to appropriate hardware, software and tutorials is required in order for learners to create bespoke images or customise existing ones.

- Learners will need to access a range of both published and online sources to provide the academic content.

# Getting started

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

## Unit 16: Cloud Storage and Collaboration Tools

### Introduction

Introduce this unit by ascertaining the learners' experience with cloud based storage and collaboration tools. Many may 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 explains why they are becoming increasingly popular for organisations.

You may consider measuring initial learner skills by using a simple skills and behaviours audit, permitting the creation of individualised starting points based on prior experience. This would help you manage practical sessions more appropriately, spending limited support time in the most efficient manner. Repeat this process at the end of the unit using the same document to measure distance travelled.

You may also consider appointing (or asking for volunteers) learners with more experience to act as classroom support.

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

### Learning aim A1 – Cloud computing in organisations

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

- Present the reasons for the 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
  - rapid elasticity.
- Ask learners to debate the relative benefits and drawbacks of the key characteristics of cloud computing in small groups. Collect feedback and conclusions from each group and share with peers.
- Invite an industry guest-speaker to showcase their decision making processes when selecting cloud based computing solutions.
- Ask learners to summarise points made by the industry guest-speaker.

### Learning aim A2 – Cloud computing models
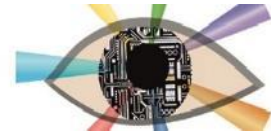
You will lead learners through the different cloud computing models which are available. This learning outcome could take five hours.

- Demonstrate the different types of cloud services, their characteristics, requirements and implications, e.g.

    o Software as a Service (SaaS)

    o Platform as a Service (PaaS)

    o 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.

- Google's Compute Engine, a well-documented IaaS has a free trial and is a good introduction to the potential of cloud based server instances. This can be simulated locally, to a degree, using 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.

- Discuss the link between virtualisation and cloud services.

- Ask learners to create a poster/wiki/electronic slideshow/podcast which details the characteristics, requirements and implication 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.

## Learning aim A3 – IT requirements of an organisation

In preparation of learners designing and deploying a cloud-based collaboration service to meet a client's needs you will present, 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 sought from local industry), detail an organisation's current IT systems.

- Ask learners, working in pairs, to identify the services that the organisation provides.

- For each service, show how cloud services can support them, e.g. secured cloud backup of confidential client data.

- Discuss customers' needs, expectations and how the service delivery model may be affected by a move to a cloud-based solution.

- Ask learners, working in small groups, to identify how a cloud-based solution may alter or impact their job requirements, accessibility issues, working styles and patterns.

- Discuss how the service delivery point may change.

- Ask learners to consider legal and ethical concerns (e.g. licensing, security and privacy) that arise when considering a move to cloud-based solutions. Note this may require an integration of learning aim A5 for learners to understand the legal implications more fully before embarking on this task.

## Learning aim A4 – Impact of cloud services

You will establish 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, backup and disaster recovery, legal ownership of data and dispute resolution.

● Ask learners to précis the key facts of your presentation into a one-page factsheet that may be issued to local SMEs who are considering cloud-based solutions.

● Compare and contrast the issues related to data and processing residing regions that may not have appropriate laws covering protection and use of data.

## Learning aim A5 – Legal requirements

You will detail the current and relevant UK legal requirements that impact the planning, use and deployment of cloud services by organisations. Learning aim A5 should take approximately four hours.
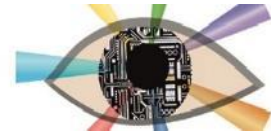
● Present a summary of the relevant legislation and their key tenets, making explicit links to pertinent issues, e.g. Data Protection Act 1998 and the requirements it places on organisations to keep data secure (a looming issue in cloud-based storage solutions).

● Generate learner-driven group or round-table discussion using relevant case studies.

● The use of classroom 'courts' with learners role playing the various parts (defendant, prosecution, defence, jury and expert witnesses) and you as the Judge can be particularly effective when paired with the legal frameworks relevant to this subject (see specification for the recommended list).

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

## Learning aim B1 – Planning cloud-based collaboration solutions

You will detail the documentation that 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.

● Walking learners through a model set of documentation produced for a client brief is a good starting point. The leveraging of previously completed learner work (when possible) is often very illuminating and can help set the bar for new learners.

● Demonstrate the different elements that form part of the 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 considerations of ethical issues. Try to cover these by highlighting bad examples where such issues had not been considered thoroughly and the resulting product has received legal, public or critical backlash.

● Encourage learners to consider and discuss technical constraints that may limit the potential solution.

● Using a sample client brief, allow learners to solve problem and design a solution

within a set time limit after which they can then present their efforts. In terms of formative assessment, focus on the presence, depth and range of the documentation elements produced more than the actual quality of designs (for now, as these will almost certainly improve through the programme).

## Learning aim B2 – Reviewing and refining designs

Help learners to review and refine their designs by introducing learners to 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. Remember to place additional emphasis on non-verbal communication, especially when learners are receiving feedback from client. Note this may require an integration of learning aim C4 for learners although it is likely that some coverage will have been afforded by 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. Leveraging social media is a good way to engage with SMEs to find suitable learner-friendly client briefs.

- Arrange, moderate and support client–learner role play that aims 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.

## Learning aim B3 – Development of cloud-based collaboration solutions

You will support learners towards implementing 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 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 a 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 (Google Compute Engine) or simulated through virtualised servers. Where possible deliberate 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 form into small groups of three or four and repeat the process,

logging their own actions and findings as they progress.

● Provide differentiated support and ad hoc problem solving.

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

### Learning aim C1 – Testing and maintaining cloud-based collaboration solutions

You will facilitate the learner's 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.

  o selecting suitable test users

  o gathering feedback from users

  o producing appropriate test documentation

  o making use of testing outcomes

  o performing continued maintenance.

● Select a suitable cloud-based solution and ask learners to apply suitable testing techniques to ascertain whether it is meeting its clients' identified requirements.

● Discuss learner findings.

### Learning aim C2 – Reviewing and refining cloud-based collaboration solutions
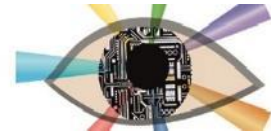
You will detail the desired workflow associated with monitoring the performance of cloud-based solutions and making updates and changes as needed. Learning aim C2 should take approximately three hours.

● Ask learners to identify potential security issues and updates, particularly through the identification of potential threats and breaches. A suitable (and well-known) case study here could be 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 the vulnerability and patch it.

● Demonstrate how to install software updates for operating systems (multiple Operating Systems should be used) 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 (relational database, web server, code frameworks etc).

● Debate support for different interface/input methods.

● Support learners in round-robin practical activities to review and refine cloud based services on a virtualised server for PaaS and/or a cloud based IaaS.

### Learning aim C3 – Lessons learned from developing cloud-based collaboration solutions

You will help learners to evaluate the effectiveness of cloud-based collaborative solutions. Learning aim C3 should take approximately two hours.

● For a given case study, ask learners to create a document (manual or electronic) that allows them to record key questions that help to evaluate the effectiveness of

a solution. Learners should consider these key questions:

- o how well the solution matched the identified client's requirements
- o the efficiency of the solution
- o the solution's ease of use
- o any issues arising during testing and maintenance, e.g. bugs, identified vulnerabilities
- o solution stability, particularly those affecting connectivity and loss of service
- o potential update schedule
- o how the implemented solutions could be improved
- o alternate solutions that could be implemented if the brief were reattempted.

- ● Ask learners to present their findings to their peers.
- ● Ask peers to provide constructive feedback.

## Learning aim C4 – Presentation skills

You will encourage learners to think about (and practise) their presentation skills. Learning aim C4 should take approximately two hours. A communications specialist, if preferred, may deliver this topic.

- ● Discuss and demonstrate the following communication skills using a variety of scenarios and physical surroundings (including online):
  - o written styles including email, design documentation, recording documentation, reports and visual aids for presentation use
  - o verbal communication requirements, including one-to-one and group informal and formal situations
  - o use of tone and language for verbal and written communications to convey intended meaning
  - o strategies used to make a positive and constructive impact on audience, e.g. positive and engaging tone, technical and vocational language suitable for intended audience and the avoidance of jargons
  - o how to respond constructively to the contributions of others.

- ● Task learners with practising a range of communication activities to sharpen their skills, e.g.
  - o writing formal reports
  - o writing informal emails
  - o presentation (peers, guests etc)
  - o leading a discussion (role play etc)
  - o leading a formal meeting (role play etc).

- ● Identify strengths and areas for improvements 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.

## Learning aim C5 – Reviewing own skills, knowledge and behaviours applied

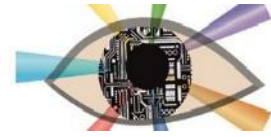Help learners to reassess their professional behaviours. Learning aim C5 should take approximately two hours.

- ● You should now reissue the skills and behaviours audit completed by learners in the

first session so that they can now revisit the document and make additional observations about where and how they feel they have improved. Learners may also find it useful to reference their ILPs when completing this task.

● Learners should use the internet (or the centre's own learning centre resources if available) and identify sources such as videos or other materials that would help them to improve the skills they identified as needing improvement. A combined list of resources from all learners should be published and/or shared by the class.

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

Depending on the choice of project, the following units will provide useful underpinning knowledge and skills that can be drawn on to create the deliverables:

- 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: IT Service Delivery

- Unit 15: 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 Nationals in Information Technology. Check the Pearson website (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 Publishing, 2010 ISBN 9781849014069 – 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 9781449360887 – An introductory text that considers the basics while also benefiting from some coding examples

Crookes D, *Cloud Computing in Easy Steps*, In Easy Steps, 2012 ISBN 9781840785326 – This is essentially a 'how to' book. It is not targeted at advanced developers, but does explain some of the familiar concepts like SkyDrive, Dropbox and Apple iCloud in a way that is easy to access by a wide variety of learners.

Kavis MJ, *Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)*, John Wiley & Sons, 2014 ISBN 9781118617618 – Well put together, this book provides some interesting perspectives on what to look for (and primarily what to avoid) when moving from a physical to a cloud architecture in addition to providing a solid introduction to the concepts of cloud computing.

Williams MI, *A Quick Start Guide to Cloud Computing: Moving Your Business into the Cloud (New Tools for Business)*, Kogan Page Publishers, 2010 ISBN 9780749461300 – 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* (Future Publishing) – http://cloudcomputingintelligence.com/

*Cloud Computing Magazine* – http://cloud-computing.tmcnet.com/

*IEEE Cloud Computing* – https://www.computer.org/cloud-computing/

## Videos

Cloud Computing: What is Cloud Computing?

(https://www.youtube.com/watch?v=uYGQcmZUTaw)

Changes to computer thinking – Stephen Fry explains cloud computing

(https://www.youtube.com/watch?v=J9LK6EtxzgM)

The Three Ways to Cloud Compute

(https://www.youtube.com/watch?v=SgujaIzkwrE)

Google Compute Engine – Ten Minute Test Drive: Set Up your own Web Server

(https://www.youtube.com/watch?v=LrjpcR-IJwY)

Cloud Wars: Amazon (AWS) vs. Google (GCP) vs. Microsoft (Azure)

(https://www.youtube.com/watch?v=342KEaxFVjM)

## Websites

https://cloud.google.com/compute/ – Google Cloud Platform – Google Compute Engine delivers virtual machines running in data centres and across a worldwide fibre network.

https://cve.mitre.org/ – Common Vulnerabilities and Exposures – An online dictionary of publicly known information security vulnerabilities and exposures

https://www.docker.com/ – Docker – A popular software containerisation platform for easier deployment in smaller PaaS solutions

https://www.thetechpartnership.com/ – The Tech Partnership – A network of employers working to create skills for the UK's digital economy

www.vagrantup.com – HashiCorp Vagrant – Create and configure lightweight, reproducible and portable development environments as might be used in smaller PaaS solutions.

https://www.virtualbox.org/ – Oracle VM VirtualBox – A powerful x86 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.*
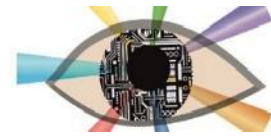
# Unit 17: Digital 2D and 3D Graphics

## Delivery guidance

This optional unit presents learners with the opportunity to explore two-dimensional (2D) and three-dimensional (3D) digital graphics using commercially relevant tools and techniques.

Digital graphics are typically the key component in most types of modern media presentations, including websites, print and broadcast media and videogames.

The key to creating attractive, engaging and commercially valuable digital graphic relies on three core skills:

- understanding the characteristics of visual communications

- being able to interpret a client brief correctly to design a suitable digital graphic solution

- having the practical skills and appropriate workflow with software tools to develop designs into audience-ready assets that are fit for the purpose.

This unit will provide learners with underpinning knowledge that helps them to investigate different forms of 2D and 3D digital graphics, their commercial applications and the techniques and skills required to generate them confidently and creatively.

Learners should develop their visual communication skills, converting project briefs, research and thoughts into practical ideas that they should be able to evaluate with peers and present to clients with equal aplomb.

If there are opportunities to involve local employers as clients, this will enhance the project and the learner experience.

There are also many opportunities for you to link and embed learning aims with other technical units, for example, a learner could use their 2D digital graphic as per the following diagram.
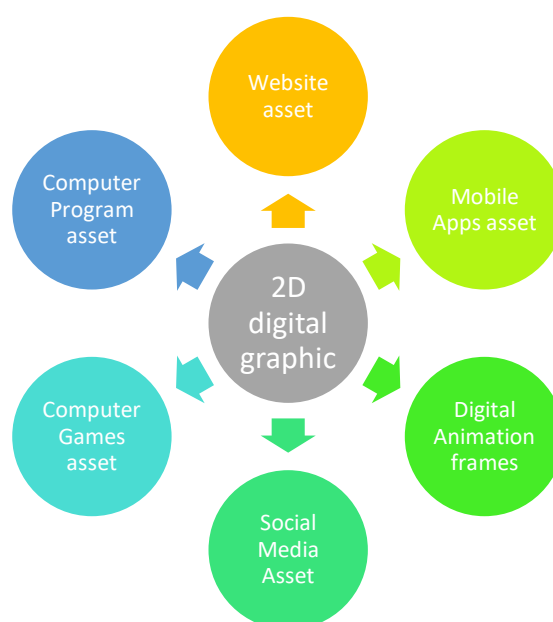
It would be ideal if the class or course had a social media page, as this is a good way for learners to share some of their documented outcomes as recommended in this guide and in the scheme of work.

## Approaching the unit

This unit lends itself to a three-fold approach to learning:

- research-based investigation into visual communication, media industry and relevant legal requirements

- free form and client brief-led exploration of design ideas in 2D and 3D

- practical skill-based and goal-oriented product of 2D and 3D digital graphics using commercially relevant software and hardware.

Learners are likely to enjoy the problem solving of interpreting a client brief and extending their practical skill set into the realm of producing digital art. While it is likely that most have some prior experience of creating 2D digital graphics, the emerging journey into 3D digital graphics can be a challenge for some but often yields a greater sense of self-achievement.

Enhance each approach through the introduction of specifically selected case studies, engaging industrial visits, industry-led technical workshops, exhibitions and conferences, inspirational guest speakers and mentors (from local industry) and constructive peer critique.

Many different software products exist to create 2D and 3D digital products. It is recommended that a variety of hardware (e.g. Apple and PC) and software (open source and commercial solutions) should be experienced where possible and that learners should explore the use of other digital capture devices, for example, camera, scanner, digital tablet. You may even decide to include learners' mobile devices for a comparative effect.

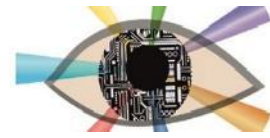## Delivering the learning aims

### Learning aim A

This aim investigates the purpose and characteristics of digital graphics that are an important part of visual communications.

As an underpinning learning aim containing the majority of the theoretical content for the unit, it can often be seen as a little dry and temptingly didactic in comparison to the more practical learner-centred learning aims which follow. Of course, it does not have to be this way; with a little creativity, it is possible to place the learner at the centre of each sub-aim.

Encouraging the learners to understand the purpose of digital graphics is best achieved through the use of socially-visible case studies, particularly digital graphics involved in multimedia campaigns which are current or have caught media attention recently (for good or bad). Naturally, discretion is advised when choosing subject matter to ensure that it should not offend – although this can prove to be a useful springboard for moderated discussion.

Data collection exercises driven through market research activities can get the learners 'out and about', asking members of a community about digital graphics and their views on their use in various products. This can be very useful when investigating the information, message and meaning being communicated to a wider audience. Potentially this could even be achieved via social-media-based polling, if preferred.

You should consider group-based projects as a useful vehicle for encouraging learners to communicate ideas visually, particularly if they have time to critique their peers and self-

evaluate. Some practitioners attempt to incorporate socially relevant themes as hidden learning when planning this type of activity.

Legal aspects have a somewhat undeserved reputation as being notoriously difficult to embed into a learning programme without resorting to tried and tested research-and-present style tasks. Although this is a practical approach, the leveraging of case studies, particularly, prominent infringements and settlements covered in the press offer a reasonable alternative for group or round-table discussion. The use of classroom 'courts' with learners role playing the various parts (defendant, prosecution, defence, jury, expert witnesses) and you as the Judge can be particularly effective when paired with the legal frameworks relevant to this subject. Cases where the Human Rights Act (1998) and the Equality Act (2010) or the Copyright, Designs and Patents Act (1998) appear to have been breached offer a multitude of discussion points and, often, very lively participation!

The second sub-aim focuses on the technical vocabulary of 2D and 3D digital graphics, often offering thematic links with material that may be covered in Unit 1. Concepts such as differences between raster and vector-based images are best demonstrated through the creation and manipulation of images using commercial software. After suitable images have been created, it should be possible to highlight the different structures and features of each format, comparing and contrasting their advantages and disadvantages, particularly the vector's ability to scale proportionately without losing details or increasing the file size. Some technical aspects such as resolution, sampling and bit depth often yield many opportunities for learners to engage in subject-specific numeracy, reinforcing their arithmetic operations and number systems (especially binary and hexadecimal).

Selecting commercial applications of raster-based 2D images is relatively straightforward and makes good individual or group-based case studies to explore. Learners could create their own 2D raster assets for an assigned class-based task (or for use in other unit work) to reinforce their understanding of the format, its creation and features. You may repeat this type of activity for vector-based images although placing more focus on the creation of logos, fonts or clip-art would be most beneficial, as these applications suit that image format much better.

The principles of vector images crucially involve common geometric shapes (vertices, lines, curves, edges, polygons and meshes) and, combined with the use of coordinate geometry, again offer firm (and practical) links to mathematics which can be explored by learners.

3D digital images can be represented in the 2D form but, ultimately, shine more brightly when explored in 3D space so the use of an appropriate 3D software to explore these concepts is highly recommended. Many 3D design applications are available but focus should be on packages that learners could legally use at home and which represent a good stepping stone to the more heavyweight solutions that are used commercially or in higher education. After all, the underlying 3D principles are universal; only the specific software workflows may differ. A good tactic when teaching these aspects of geometric theory is to encourage learners to breakdown everyday objects (e.g. ice-creams, Star Wars' R2-D2, mobile telephone) in its simple geons and in doing so should encourage the learners to describe these objects in a professional manner using the correct geometric vocabulary.

Learners can then practise building these simple everyday objects using your chosen 3D design software by using appropriate mesh construction and rendering tools. Creating a '3D skills' driving licence that covers the different features and functions of the 3D design software is typically a fun way to introduce each new aspect, reinforce it and challenge friendly competition. An additional benefit in using this technique is that it is possible to track learner progress (and outcomes) in a very bespoke and individualised fashion.

You may find that group discussion, demonstration or presentation can be useful methods for examining the applications of 3D images, pinpointing their use in TV programmes, films, videogames, virtual reality, health and architecture by selecting appropriate examples, such as 3D models and special effects in popular films, virtual tours of famous museums or interactive graphics in the current hit videogame.

It is important that learners are aware of the impact of 2D and 3D digital graphic principles on the usability of an image. There are a number of ways to achieve this but you may favour the tried-and-tested approach where properties of an image are individually modified, for example, by rendering quality, resolution and anti-aliasing to demonstrate that specific effect. For example, the lack of anti-aliasing on an image will cause its diagonal lines to appear somewhat rough and jagged.

The final area covered by the first learning aim turns the learner's attention to the hardware and software tools used for creating and editing digital graphics. You should aim to give learners a firm understanding of the role of each component, for example, for hardware, capturing images, processing them internally and outputting them on screen or paper and for software, the different types of applications used to manage and manipulate such images.

Again, you should encourage hands-on experience of both hardware components and a range of software applications and tools. Learners may find some benefit from having this part of the learning outcome thematically linked to Unit 1's Assessment Outcome area A1 – Digital devices, their functions and use.

Throughout all aspects of this learning aim, building a visual dictionary of technical terms encountered to decorate the teaching space as an aide memoire is highly recommended.

### Learning aim B

The second aim focuses on the design part of the digital graphics workflow and charts the processes and techniques that learners must consider when planning the production of digital graphics (2D or 3D) to suit the required specification.
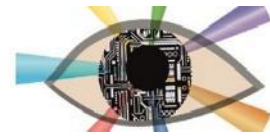
Encourage learners to think about the source of the specification, for example, from a client, self-brief or their research. Class-based practical activities can be organised which facilitate the free exchange of ideas during brainstorming, presenting ideas using mood boards, storyboards and thumbnail sketches. Although such skills should be developed and fine-tuned individually, the benefit of group or class-based feedback can be significant and warmly welcomed. Having a competitive aspect of these, for example, rotating groups pitching ideas against a live client brief can generate much momentum. If external projects are difficult to source, options typically exist to support other departments within the parent institution, for example, creating signage for an open evening, website graphics or product livery.

You should also direct the learners' focus towards the image quality requirements, the file formats preferred (in terms of wider compression and compatibility), and the processing and editing techniques required to achieve the desired outcomes.

Learners typically have to be convinced that documentation is an important part of any design, completed with the same level of care and attention as the digital graphic. This fact is not limited to digital graphic work so the need can be thematically linked to other disciplines, for example, computer programming. Each learner should be aware of the items that comprise design documentation for the subject, knowing how to generate each aspect professionally and its defined purpose.

Learners need to understand the various options for processing digital graphics before they practically apply them. As such presenting a primer on the various processing, editing, and compression techniques during this learning aim can be very insightful. The impact that each could potentially have on the user's experience should also be outlined with particular reference to the quality, compatibility and usability. Each selected technique may also have particular hardware or software requirements that need to be recognised and accommodated, for example, improving the clarity and crispness of textured 3D objects (usually in videogames) using anisotropic filtering is typically hardware reliant.

Once designs are created, they need to be reviewed and, if necessary, refined. This commonly involves working with clients and peers to improve the quality, effectiveness and

appropriateness of the design with respect to the client's original brief. The learners' communication skills come to fore here and you should encourage them to discuss designs outside their close circle of friends in order to gain wider experience, particularly with people who may not necessarily agree with their design ideas. Learners should then update designs in their documentation, reflecting the suggested (and accepted) changes. A mock design project with iterative feedback, preferably from someone outside the programme of study, is a great way to simulate this process in as realistic manner as possible.

**Learning aim C**

The final learning aim focuses on the practical development of the previously made 2D and 3D designs into final products that meet a client brief.

Broadly speaking you can divide the content into three areas: an examination of the 2D and 3D tools with which learners should gain technical competence, the ability of the learner to review and evaluate their final products (with input gathered from others) and the development of professional attributes that demonstrate their personal growth in terms of skills, knowledge and behaviours.

Learners should be able to demonstrate the practical skills necessary to create and manipulate 2D images for a given purpose using the tools available in the selected application software. Skills such as the ability to freehand draw can be difficult to encourage and develop in IT learners but with persistence most learners attain a reasonable level; the use of graphic tablets may be preferable for some, offering a viable alternative to the scanning of traditional hand-drawn imagery. Creating a checklist of the standard skill set for 2D image creation and manipulation is generally a good idea, supported through online tutorials (VLE or web-based), which learners can practise at their own pace and even in their personal time; not all learners will accumulate these skills in the same order or pace so flexible delivery, perhaps learner-led, is a useful option. Conducting live demonstrations are a sensible way to introduce new techniques but there is undeniably some advantage in advocating a rotating pilot/navigator-style arrangement with learners taking time in supporting their peers' development. Using video tutorials created by other learners affords another fun and totally different alternative to formal instruction.

Naturally, you should formatively assess these skills through in-class activities and/or homework tasks before summarily assessing. Short and sharp testing works well here and may be suitable as a session's lead activity.

You may use a similar approach for 3D graphic tools although this type of software is notoriously more complex in terms of understanding the user interface and remembering the typically complex mouse/key combinations required, so some mild caution is advised. In addition, abbreviations and acronyms can be somewhat obtuse, for example, NURBS (non-uniform rational basis spline) and initially confusing for learners with weaker mathematic skills. For these reasons, additional in-class support and guidance is often required, particularly when working with more complex models and meshes or where learners have conceptualisation issues.

A suggested generic approach could:

- select a new model/image to create

- introduce new tool or technique that is required to create the new model/image

- demonstrate the tool/technique to learners

- ask learners to practise tool/technique

- allow learners to upload their resulting efforts to a class-accessible gallery

- moderate peer critique on each learner's effort

- record helpful tips collected by learners when using the tool/technique.

The use of lunchtime clubs for 3D modelling can be a useful option for reinforcement and encourage self-study.

Unless the offer is available in house, you could also investigate whether a representative from an approved training provider delivering specific vendor-oriented study programmes could visit and provide information about the courses and certification (particularly as some learners may opt to study such a qualification alongside or after completion of this course).

Learners should become adept at reviewing both their own efforts and those of their peers, typically through verbal critique and written feedback. You should encourage learners to benchmark their digital products against the client's requirements (the original brief), the overall quality of the image/model, any pertinent constraints (legal/ethical or technical for example, formats, polygon count and texture map sizes) and the level of optimisation that have been applied. You should expect learners to use technical terms correctly during the provision of feedback. Do not forget to tease other judgements about the digital graphics from the learners including its perceived strengths, weaknesses and how it can be improved (from a technical standpoint and in order to correctly fulfil the client brief).

Evaluation and review benefits from repeated exposure; learners may be initially reluctant to give critical feedback in a constructive fashion. However, after routinely repeating the process at the end of a practical task it soon becomes an intrinsic, normal and rewarding part of the learning process. Some practitioners may feel inclined to incentivise, promoting 'Digital Artist of the week' awards to recognise exceptional performance, for example.

The final part of this learning aim continues this theme and requires the learners to self-assess their progress in the unit. You should encourage focus on aspects such as timekeeping (vitally important in the media industry for those hoping to progress further), actively responding to feedback, supporting others and measuring progress towards set goals. The issue of individual lesson plans (ILPs), with session or weekly targets can be a useful vehicle to chart performance across a defined period for both you and the learner, providing a handy repository that to draw upon. Revisiting the skills and behaviour audit completed at the start of the unit is also highly recommended.

## Assessment model (in internally assessed units)

| Learning aim | Key content areas | Recommended assessment approach |
|---|---|---|
| **A** Investigate the purpose and characteristics of digital graphics that are an important part of visual communications | **A1** Purpose of and legal requirements for digital graphics<br><br>**A2** Representation and applications of 2D and 3D digital graphics<br><br>**A3** Hardware and software tools for digital graphics | A report or detailed presentation on the purpose and technical characteristics of, and legal considerations for, 2D and 3D digital graphics. |
| **B** Design 2D and 3D digital graphics products to meet a client brief | **B1** Planning digital graphics<br><br>**B2** Design documentation for digital graphics<br><br>**B3** Digital graphics processing and techniques<br><br>**B4** Reviewing and refining designs | A design specification showing the planning and design of 2D and 3D digital graphics products that could be used in a larger media product.<br><br>Digital graphics files that fulfil the design specifications, accompanied by supporting development documentation. |
| **C** Develop 2D and 3D digital graphics products to meet a client brief | **C1** Tools and techniques for developing digital graphics<br><br>**C2** Reviewing the final 2D and 3D digital graphics products<br><br>**C3** Professional behaviours | An evaluation of the digital graphics against the client brief. A record of personal performance while completing the activity, such as whether work was submitted on time. |

## Assessment guidance

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

### Assignment 1 (learning aim A)

A thoroughly researched report, digital arts magazine-style article or learner-led presentation focusing on the hardware and software tools used for the creation of 2D and 3D digital graphics, their applications and impact in the wider media industry and the legal requirements that must be observed.

Offering learners a choice of presentation medium for their evidence will often encourage individual thinking and allow them to embrace the various possibilities presented by the medium chosen, for example, integrating interactive 3D assets into their presentation or including specifically created 2D art in a magazine article.

Things to remember to offer the best opportunity for learner success:

- Learners must include coverage of the different types of digital graphic products (both 2D and 3D), using technical language accurately in their descriptions. Comparison of different 2D formats, that is raster versus vector-based is essential, demonstrating a firm understand on how this relates to file formats, scaling accuracy and resolution.

- Learners should identify typical uses of different types of 2D and 3D images (e.g. videogame assets) and their purpose (entertaining users).

- Learners should explain the purpose and legal considerations when creating different types of digital graphic products.

- If the report format is selected, it would ideally follow a recognised format (either formal or informal) and should be presented as a professional business document, with consistent use of correct grammar and spelling, and correct referencing of information sources.

- Access to appropriate hardware, software and tutorials is required in order for learners to create bespoke images or customise existing ones.

- Learners will need to access a range of both published and online sources to provide the academic content.

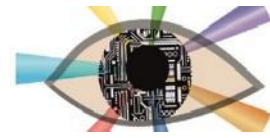## Assignment 2 (learning aims B and C)

Ideally, you could link this assignment with other units to form part of an integrative assignment. Examples could include building assets (buttons, carousel images etc) for a customer's website, creating graphics (sprites, backgrounds etc) for an interactive game or artwork assets for use in a mobile app.

Alternatively, the use of a 'live' industry brief from a sponsor or mentor can provide fertile ground for creative efforts. Where possible it should include hidden learning which can support progress in other units and afford some inter-curricula links.

The task must involve the design and creation of 2D and 3D assets that should be fit for a given purpose.

Things to be remembered to offer the best opportunity for learner success:

- Learners should demonstrate evidence of research that is pertinent to the client brief, generating a range of potential designs for each digital product required. Learner notes that justify their decisions through a clear understanding of core 2D and 3D design principles, the intended audience and purpose should accompany each design.

- Once final designs have been selected these should be developed using appropriate hardware and software tools. Expect the learner to document each part of creation process, providing detailed explanation of the tools and techniques used with a rationale.

- Completed digital images need to be evaluated by the learner drawing upon the technical standard of the final product, the range of techniques used and how closely they have resolved the client's requirements.

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

- Access to appropriate hardware, software and tutorials is required in order for learners to create bespoke images or customise existing ones.

- Learners will need to access a range of both published and online sources to provide the academic content.

# Getting started

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

## Unit 17: Digital 2D and 3D Graphics

### Introduction

Introduce this unit by ascertaining the learners' experience with digital graphics (most will be limited to 2D products) and detail the full expectation of the unit's outcomes and the skills (and professional behaviours) it is hoped the learners will develop before its completion.

Use of previous cohorts' work (if available) is a very useful touchstone for new learners, especially if they compare favourably with commercial examples, as they will inspire and provide realistic targets to which they may aspire. Providing well-known examples of 2D and 3D digital graphics is a sound tactic, especially if culled from popular media such as film, TV, advertisements and videogames.

You may consider measuring initial learner skills by using a simple skills and behaviours audit, permitting the creation of individualised starting points based on prior experience. This would help you manage practical sessions more appropriately, spending limited support time in the most efficient manner. Repeat this process at the end of the unit using the same document to measure the distance travelled.

You may also consider appointing (or asking for volunteer) learners with more experience to act as classroom support.

### Learning aim A – Investigate the purpose and characteristics of digital graphics that are an important part of visual communications

### Learning aim A1 – Purpose of and legal requirements for digital graphics

You will detail the purpose and legal requirements of digital graphics. Legal requirements are limited to UK legislation although encouraging a wider geographic awareness in learners is recommended. Learning aim A1 should take approximately 4 hours.

- Define the key purposes of digital graphics
  - Conveying information, messages and meaning to a target audience
  - Visualise, communicate, verify and evaluate potential ideas to a target audience.

Use of case studies can be particularly helpful here, particularly mixing examples that have been successful and those that have not (for contrast). Common examples could include company logos, videogame cover art, film posters, advertising campaigns etc particularly where a change of artistic direction can be evidenced. These types of activity often provide opportunities for open group discussion on the merits (and otherwise) of the digital graphics created and how they were used. Practical activities such as market research are a possibility.

- Present the current and relevant UK legal requirements for digital graphics
  - This should at the minimum include those covering privacy, accessibility, copyright, designs and patents. Particular emphasis should be placed on the adapting of digital graphics, including derivative use.
  - Generate learner-driven group or round-table discussion using relevant case studies.
  - The use of classroom 'courts' with learners role playing the various parts (defendant, prosecution, defence, jury, expert witnesses) and you as the Judge

can be particularly effective when paired with the legal frameworks relevant to this subject (see specification for recommended list).

## Learning aim A2 – Representation and applications of 2D and 3D digital graphics

You will delineate the differences between raster and vector-based 2D graphics, and their applications. Learning aim A2 should take approximately 8 hours.

- Demonstrate differences between raster and vector-based images through the creation and manipulation of images using commercial software, encouraging learners to note new terms they encounter.

- Learners to investigate and document the different structures and features of each format, comparing and contrasting their advantages and disadvantages, particularly the vector's ability to scale proportionately without losing details or increasing the file size.

- Learners to find examples of different commercial examples for vector and raster-based images, presenting their findings to their peers.

- Learners to create a logo for a defined purpose which they need to create using vector and raster-based tools. You should ask them to perform certain transformations on these images, e.g. scale, rotate and shear to view the impact on the image's fidelity, file size etc.
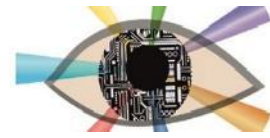
You will introduce the principles and applications of representing 3D images in digital format, including geometric theory, mesh construction, rendering, application, usability and accuracy.

- Demonstrate the creation of a 3D image using commercial software, encouraging learners to note new terms they encounter, particularly in terms of geometric theory and mesh construction.

- Present a number of everyday objects that learners can decompose into simple geons, encouraging them to describe these objects in a professional manner using the correct geometric vocabulary.

- Demonstrate the use of different rendering techniques to change the 3D model's appearance. Ask learners to make judgements about the effectiveness of the different techniques used.

- Learners to find examples of different commercial examples of 3D digital graphics, presenting their findings to their peers (this could be done as a scavenger hunt covering a range of media). Where possible, learners should be encouraged to investigate examples from a range of media and different periods of development. Supplement this activity with demonstrations of previous learners' 3D model work, commercial meshes etc.

- Lead a group discussion to complete the topic that questions the impact of the 2D and 3D digital graphic representation principles on their usability and accuracy. Selection of specific case studies (particularly technically flawed ones) may prove useful to illustrate points raised.

## Learning aim A3 – Hardware and software tools for digital graphics

You will establish the range of software and hardware tools commonly used in the development of 2D and 3D graphics, specifically those that capture, processing images internally and outputting them on screen or paper. Learning aim A3 should take approximately 5 hours but it is possible to amortise some time by combining with Unit 1's Assessment Outcome area A1 – Digital devices, their functions and use.

- Lead a practical session to capture, process and output digital images using digital devices. Personalisation will allow learners to capture images from their own

smartphone cameras. Capturing a real world texture (e.g. real brick wall) for use as a texture on a suitable 3D model is a good practical activity that involves a mix of different hardware devices and software.

- Learners should also make practical use of different types of software applications to manage and manipulate the images they have captured, e.g. vector-based and raster-based 2D models, 3D models, image gallery and file conversion.

- Learners should review the produced digital images in open discussion, examining the impact that the choice of hardware and software tools had on the usability and accuracy of the image. Encourage the learner to link between choices made to quality of outcomes, e.g. low capture resolution or high compression rates leading to a degraded, blocky image which lacks definition.

## Learning aim B – Design 2D and 3D digital graphics products to meet a client brief

### Learning aim B1 – Planning digital graphics

Lead class discussion that encourages learners to think about the processes and techniques to consider when planning the production of digital graphics. Learning aim B1 should take approximately 3 hours.

- Issue learners with a client brief from a suitable case study

- Ask learners to consider the source of the specification

- Explore different techniques for generating ideas, e.g. brainstorming, presenting ideas using mood boards, storyboards and thumbnail sketches

- Discuss the technical (rather than aesthetic) characteristics that define an image's inherent quality, e.g. quality and compatibility

- Ask learners to provide an overview of the different processing and editing techniques that they think would be required to produce the target image

- Discuss the various file and compression formats, selecting (with justification) the most appropriate for the task at hand.

### Learning aim B2 – Design documentation for digital graphics

You will detail the documentation that learners need to generate for their digital graphic designs. Learning aim B2 should take approximately 5 hours.

- Walk learners through a model set of documentation produced for a client brief is a good starting point. The leveraging of previously completed learner work is often very illuminating and can help set the bar for new learners.

- Demonstrate the different elements that form part of the design's documentation, e.g. client brief, research, themes and aesthetics, legal and ethical considerations, reference imagery, mood board, design sketches, ready-made assets used etc.

- Provide guidelines for documentation elements such as file naming, storage location, intended platform, hardware and software requirements.

- Using a sample client brief, allow learners to problem solve and design a solution within a set time limit after which they can then present their efforts. In terms of formative assessment, focus on the presence, depth and range of the documentation elements produced more than the actual quality of designs (for now, as these will almost certainly improve through the programme).

### Learning aim B3 – Digital graphics processing and techniques

Introduce learners to the concepts of digital graphics processing and techniques. Learning aim B3 should take approximately 7 hours.

- Prepare an interactive slide presentation or web application that demonstrates each processing and editing technique with a 'before' and 'after' view of the digital graphic, e.g. pre and post free-hand rotation.

- Demonstrate different compression techniques (lossless and lossy) and their impact on image fidelity and file size.

- Discuss the user experience in terms of quality, compatibility, usability (particularly mindful of purpose and visual disabilities, e.g. graphics for user interfaces), hardware and software requirements.

### Learning aim B4 – Reviewing and refining designs

Help learner to review and refine their designs. Learning aim B4 should take approximately 5 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. Remember to place additional emphasis on non-verbal communication, especially when learners are receiving feedback from client.

- 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. Leveraging social media is a good way to engage with SMEs to find suitable learner-friendly client briefs.

- Arrange, moderate and support client/learner role play that aims to encourage learners to accept constructive feedback from stakeholders and refine their designs accordingly.

- Ask learners to update their design specifications based on the feedback received.
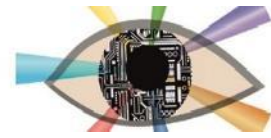
- Review the changes made.

### Learning aim C – Develop 2D and 3D digital graphics products to meet a client brief

### Learning aim C1 – Tools and techniques for developing digital graphics

You will facilitate the learner's ability to use appropriate tools and techniques to create 2D and 3D digital graphics. Learning aim C1 should take approximately 20 hours plus additional self-study to hone skills appropriately.

- Introduce each tool and technique specified for 2D and 3D graphics, explaining its purpose and application. If you have time you may enrich this suggested list.

- Provide instruction and/or written, video, pilot/navigator-style support for each learner as they prefer. Issue an ILP to each learner with individualised targets.

- Monitor and support learners throughout, utilising trustee classroom assistance as necessary.

- Allow learners to upload their resulting efforts to a class-accessible gallery.

- Moderate peer critique on each learner's effort.

- Record helpful tips collected by learners when using the tool/technique.

### Learning aim C2 – Reviewing the final 2D and 3D digital graphics products

You will lead and moderate reviews of final 2D and 3D digital graphics by the learner, learner peers, their clients and other interested parties. Learning aim C2 should take approximately 3 hours.

- Learners produce a gallery (physical or electronic) of their 2D and 3D work.

- Invite open critique from learner peers, clients and other stakeholders.

- Incentivise, promoting 'Digital Artist of the week' awards (or real prizes) to recognise exceptional performance, for example.

- Learners should personally review each 2D and 3D artwork they have created using the recommended checklist (see specification) and feedback from others.

- Learner should recommend improvements that could be made.

- Ideally, learners' work could also be put on display at key locations around the institution and a retrospective exhibition of the best work organised at the end of the programme.

- Where possible and permissible, keep copies of a range of learners' work to use with next cohort.

**Learning aim C3 – Professional behaviours**

Help learners to reassess their professional behaviours. Learning aim C3 should take approximately 2 hours.

- You should now reissue the skills and behaviours audit completed by learners in the first session so that they can now revisit the document and make additional observations about where and how they feel they have improved. Learners may also find it useful to reference their ILPs when completing this task.

- Learners should use the internet (or the centre's own learning centre resources if any exist) and identify sources such as videos or other materials that would help them to improve the skills they identified as needing improvement. A combined list of resources from all learners should be published and/or shared by the class.

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

Depending on the choice of project, the following units will provide useful underpinning knowledge and skills that can be drawn on to create the deliverables:

- Unit 6: Website Development
- Unit 7: Mobile Apps Development
- Unit 8: Computer Games Development
- Unit 15: Customising and Integrating Applications
- Unit 18: Digital Animation and Effects

# Resources

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

### Textbooks

Blain JM, *The Complete Guide to Blender Graphics* (Third Edition), CRC Press, 2016 ISBN-10 1498746454, ISBN-13 9781498746458 – Delving deeper into the process of creating 3D models in Blender.

Dabner D, Stewart S and Zempol E, *Graphic Design School* (Fifth Edition), Wiley, 2010 ISBN-10 0500291438, ISBN-13 9780500291436 – Focuses on principles of good graphic design.

Derakhshani D, *Introducing Autodesk Maya 2016*, John Wiley & Sons, 2015 ISBN-10 1118862848, ISBN-13 9781118862841 – Introductory text with good examples of working with industry-popular 3D software.

Faulkner A and Gyncild B, *Adobe Photoshop CC Classroom in a Book (2014 release)*, 2014 Adobe Press, ISBN-10 0134308131, ISBN-13 9780134308135 – A primer for working with raster images using industry-standard software.

Gumster J van, *Blender For Dummies*, John Wiley & Sons, 2015 ISBN-10 1119039533, ISBN-13 9781119039532 – Getting started building 3D models in Blender; assumes no prior experience.

Team, Adobe Creative, *Adobe Illustrator CS6,* Peachpit Press, 2012 ISBN-10 032182248X, ISBN-13 9780321822482 – A primer for working with vector images using industry-standard software.
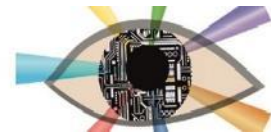
### Journals

*Computer Arts Magazine* – http://www.creativebloq.com/computer-arts-magazine

*Computer Graphics World* – http://www.cgw.com/Publications/Current-Issue.aspx

*ImagineFX Magazine* – http://www.creativebloq.com/imaginefx

*3D World Magazine* – http://www.creativebloq.com/3d-world-magazine

### Videos

Adobe Photoshop Tutorials (https://www.youtube.com/user/NewWorldOps)

Blender 2.7 Tutorial series
(https://www.youtube.com/playlist?list=PLda3VoSoc_TR7X7wfblBGiRz-bvhKpGkS)

Blender Guru series (https://www.youtube.com/channel/UCOKHwx1VCdgnxwbjyb9Iu1g)

Maya How-Tos (https://www.youtube.com/user/MayaHowTos)

Beginning Illustrator: Vectors vs. Pixels explained
(https://www.youtube.com/watch?v=PJFc3KlEdLM)

**Websites**

http://www.autodesk.co.uk/products/maya/overview – Autodesk Maya 3D – Professional 3D computer modelling and animation software

https://www.blender.org/ – Open Source 3D creation suite – Free downloads, FAQ, user community, user galleries and tutorials

https://creativeskillset.org/ – Creative Skillset – Works with the UK's screen-based creative industries to develop skills and talent, from classroom to boardroom, supplying advice, industry news, information on courses and job roles.

https://www.gimp.org/ – GIMP – GNU Image Manipulation Program – A cross-platform image editor available for GNU/Linux, Mac OS X, Windows and other OS; free downloads, news, documents and tutorials.

https://inkscape.org/en/ – Inkscape – An open source professional vector graphics editor for Windows, Mac OS X and Linux; free downloads, user community, FAQs and tutorials.

*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.*
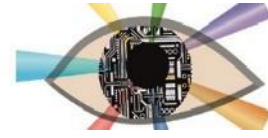
# Unit 18: Digital Animation and Effects

## Delivery guidance

This optional unit presents learners with the opportunity to explore digital animations and effects (both audio and visual) using commercially relevant tools and techniques.

Digital animations and effects are typically key components in most types of modern media presentations, including websites, advertising, broadcast media and video games.

The key to creating attractive, engaging and commercially valuable digital animation and effects relies on three core skills:

- understanding the purpose and characteristics of digital animations and effects
- being able to interpret a client brief correctly to design a suitable digital animation and effects
- having the practical skills and appropriate workflow with software tools to develop designs into audience-ready assets that are fit-for-purpose.

The unit will give learners underpinning knowledge that helps them to investigate different forms of digital animations and effects, their commercial applications and the techniques and skills required to generate them confidently and creatively.

Learners should develop their visual communication skills, converting project briefs, research and thoughts into practical ideas that they should be able to evaluate with peers and present to clients with equal aplomb.

Take opportunities to involve local employers as clients, as this will enhance both the project and learner experience.

There are also 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), for example, a learner could use their digital animation and effects to enhance film and theatre, as well as increasingly in art and design.
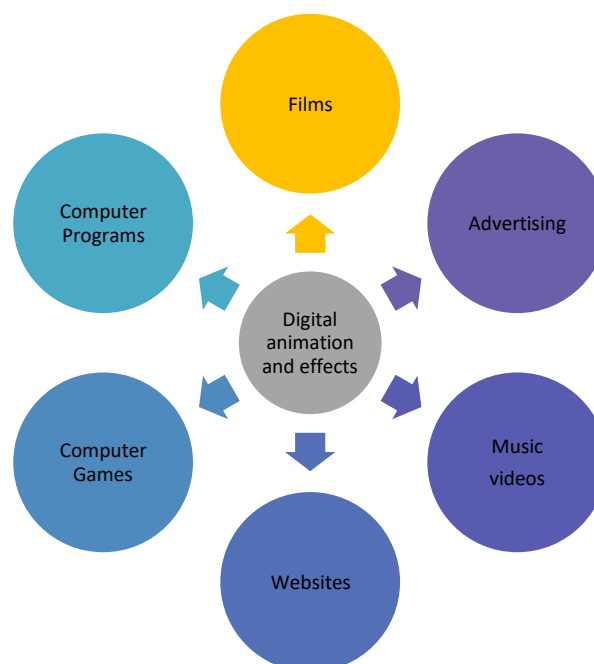
It would be ideal if the class or course had an internal platform or moodle, as this is a good way for learners to share some of their documented outcomes as recommended in this guide and in the scheme of work.

## Approaching the unit

This unit lends itself to a three-fold approach to learning:

- research-based investigation into digital animations and effects, their respective purposes, impacts and relevant legal requirements

- free form and client brief-led planning for the creation of digital effects and exploring the techniques used for creating these

- practical skills-based and goal-oriented production of digital animations and effects using commercially relevant software and hardware, as well as effectively evaluating against the original brief.

Learners are likely to enjoy the problem solving of interpreting a client brief and extending their practical skill set into the realm of producing digital animations and effects. While it is likely that most have some prior experience creating 2D and 3D digital graphics, their experience of the different animation forms may be limited.

Enhance each approach through the introduction of specifically selected case studies, engaging industrial visits, industry-led technical workshops, exhibitions and conferences, inspirational guest speakers and mentors (from local industry) and constructive peer critique.

Many different software products exist to create engaging digital animations and effects. It is recommended that a variety of hardware (e.g. Apple and PC) and software (open-source and commercial solutions) should be experienced where possible and that learners should explore the use of other digital capture devices, for example, video capture, green screen, camera, scanner, digital tablet. You may even decide to include learners' mobile devices for comparative effect.
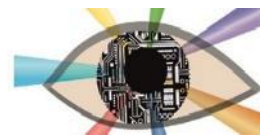
## Delivering the learning aims

### Learning aim A

This aim investigates the purpose and characteristics of digital animations and effects that form an important part of visual communications.

As an underpinning learning aim containing the majority of the theoretical content for the unit, it can often be seen as a little dry and temptingly didactic in comparison to the more practical learner-centred learning aims that follow. Of course, it does not have to be this way; with a little creativity, it is possible to place the learner at the centre of each sub-aim.

Encouraging the learners to understand the purpose of digital animations is best achieved through the use of socially visible case studies, particularly digital graphics involved in multimedia campaigns, which are current or have caught media attention recently (for good or bad). Naturally, discretion is advised when choosing subject matter to ensure that it should not offend, although this can prove to be a useful springboard for moderated discussion if it does. Some examples of that could include popular advertising campaigns such as Monty the penguin or movies such as Jurassic World. As this is a constantly developing field, tutors should try to ensure that examples are relevant.

You may find that group discussion, demonstration or presentation can be useful methods for examining the applications of 3D images and animations, pinpointing their use in TV programmes, films, video games, virtual reality, health and architecture by selecting appropriate examples, for example, 3D models and special effects in popular films, virtual tours of famous museums or interactive graphics in the current hit video game.

Learners should discuss current relevant examples for a wide variety of purposes (e.g. education, entertainment). This gives an opportunity to review the types of animation used, and why they may have been chosen, for example, what effects were the creators trying to achieve?

You should consider group-based projects as a useful vehicle for encouraging learners to communicate ideas visually, particularly if they have time to critique their peers and self-evaluate. Some practitioners attempt to incorporate socially relevant themes as hidden learning when planning this type of activity. When the designs have been developed, this is also linked to learning aim C, Develop a digital animation and effects product to meet a client brief.

A practical approach to teaching legal aspects would be through the leveraging of case studies, particularly prominent infringements and settlements covered in the press, as the focus of group or round-table discussion. The use of classroom 'courts' with learners role playing the various parts (defendant, prosecution, defence, jury, expert witnesses) and you as the Judge can be particularly effective when paired with the legal frameworks relevant to this subject. Cases where the Human Rights Act (1998) and the Equality Act (2010) or the Copyright, Designs and Patents Act (1998) appear to have been breached offer a multitude of discussion points and, often, very lively participation! Note that legal aspects are revisited in the second learning aim as part of the design documentation, offering an opportunity for reinforcement.

The second sub-aim focuses on the basic principles of creating digital animations, including a variety of traditional 2D production techniques, 3D modelling and animation concepts. Learners could be introduced to software applications such as open source Pencil2D, or commercial Adobe Animate CC. Blender is a free 3D animation tool, and the Autodesk suite is also free to use with an educational license. These will give learners a broad overview of free and industry standard software.

The principles of vector images and animation crucially involve common geometric shapes (vertices, lines, curves, edges, polygons and meshes) and, combined with the use of coordinate geometry, again offer firm (and practical) links to mathematics that can be explored by learners.

3D techniques can be represented in 2D form but, ultimately, shine more brightly when explored in 3D space, so the use of appropriate 3D software to explore these concepts is highly recommended. Many 3D design applications are available, but focus should be on packages that learners could legally use a home and that represent a good stepping-stone to the more heavyweight solutions that are used commercially or in higher education. After all, the underlying 3D principles are universal; only the specific software workflows may differ. A good tactic when teaching these aspects of geometric theory is to encourage learners to break down everyday objects (e.g. an ice-cream, Star Wars' R2-D2, mobile telephone) in their simple geons and in doing so should encourage the learners to describe these objects in a professional manner using the correct geometric vocabulary.

Learners can then practise building these simple everyday objects using your chosen 3D design software by using appropriate mesh construction and rendering tools. Creating a '3D skills' driving licence that covers the different features and functions of the 3D design software is typically a fun way to introduce each new aspect, reinforce it and challenge friendly competition. An additional benefit to using this technique is that it is possible to track learner progress (and outcomes) in a very bespoke and individualised fashion.

It is important that learners are aware of the principles involved in creating both visual and audio effects. Although practical emphasis can be most gainfully placed on compositing, namely the smooth integration of live footage and computer animation or visual effects, it is important to recognise techniques such as motion tracking, motion capture, augmented reality and virtual reality, although these can be more difficult to recreate in a classroom environment.

The final area covered by the first learning aim turns the learner's attention to the hardware and software tools used for creating and editing digital animations and effects. You should aim to give learners a firm understanding of the role of each component, for example, for hardware for capturing, processing images internally, outputting them on screen or paper and for software, the different types of applications used to manage and manipulate such assets.

Again, you should encourage hands-on experience of both hardware components and a range of software applications and tools. Learners may find some benefit from having this part of the learning outcome thematically linked to Unit 1's Assessment Outcome area A1 – Digital devices, their functions and use.

As an alternative delivery model – centres could introduce learners briefly to the tools before teaching the techniques associated with animating – this would introduce learners to software to be used later in the module and help give context to how these techniques are implemented.

Throughout all aspects of this learning aim, building a visual dictionary of technical terms encountered to decorate the teaching space as an aide memoire is highly recommended.

**Learning aim B**

The second aim focuses on the design part of the digital animation and effects workflow and charts the processes and techniques that learners must consider when planning the production of such digital assets to suit the required specification.

Encourage learners to think about the source of the specification, for example, from a client, self-brief or their research. Class-based practical activities can be organised that facilitate the free exchange of ideas during brainstorming, presenting ideas using mood boards, storyboards and thumbnail sketches. Although such skills should be developed and fine-tuned individually, the benefit of group or class-based feedback can be significant and warmly welcomed. Having a competitive aspect of these, for example, rotating groups pitching ideas against a live client brief can generate much momentum. If external projects are difficult to source, options typically exist to support other departments within the parent institution, for example, creating signage for an open evening, website graphics or product livery.

You should also direct the learners' focus towards the image quality requirements, the file formats preferred (in terms of wider compression and compatibility) and the processing and editing techniques required to achieve the desired outcomes (this could be done by giving learners small group scenarios, e.g. billboards with animations, TV shows, website animated graphics etc and choosing/presenting the appropriate solution; here, learners will have to look at file types, quality versus size etc).

Learners typically have to be convinced that documentation is an important part of any design, completed with the same level of care and attention as the digital assets. This fact is not limited to digital animation and effects work, so the need can be thematically linked to other disciplines, for example, computer programming. Each learner should be aware of the items that comprise design documentation for the subject, knowing how to generate each aspect professionally and its defined purpose (to demonstrate the importance of having clear design documentation in place, learners can engage in a Simon says activity – give a learners an image and they need to describe to the next person, that has to draw it, and so on – by the end of the line, the final image will most likely have no relevance to the original. To follow on from this, develop suitable design
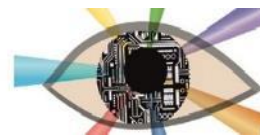
documents for a scenario as a class; this can be used for reference for assessments later on).

Learners need to understand the various options for processing digital graphics before they practically apply them. As such, presenting a primer on the various processing, editing, and compression techniques during this learning aim can be very insightful. The impact that each could potentially have on the user's experience should also be outlined with particular reference to the quality, compatibility and usability. Each selected technique may also have particular hardware or software requirements that need to be recognised and accommodated, for example, improving the clarity and crispness of textured 3D objects (usually in video games) using anisotropic filtering is typically hardware reliant.

Once designs are created, they need to be reviewed and, if necessary, refined. This commonly involves working with clients and peers to improve the quality, effectiveness and appropriateness of the design with respect to the client's original brief. The learners' communication skills come to fore here, and you should encourage them to discuss designs outside their close circle of friends in order to gain wider experience, particularly with people who may not necessarily agree with their design ideas.

Learners should then update designs in their documentation, reflecting the suggested (and accepted) changes. A mock design project with iterative feedback, preferably from someone outside the programme of study, is a great way to simulate this process in as realistic manner as possible.

### Learning aim C

The final learning aim focuses on the practical development of the previously made animation and effect designs into final products that meet a client brief.

Broadly speaking, you can divide the content into three areas: an examination of tools with which learners should gain technical competence, the ability of the learner to review and evaluate their final products (with input gathered from others) and the development of professional attributes that demonstrate their personal growth in terms of skills, knowledge and behaviours.

Learners should be able to demonstrate the practical skills necessary to create and manipulate still and moving digital images for a given purpose using the tools available in the selected application software. Skills such as the ability to freehand draw can be difficult to encourage and develop in IT learners, but persistence will usually see most learners attain a reasonable level; the use of graphic tablets may be preferable for some, offering a viable alternative to the scanning of traditional hand-drawn imagery. Creating a checklist of the standard skills set for 2D image creation and manipulation is generally a good idea, supported through online tutorials (VLE or web-based), which learners can practise at their own pace and even in their personal time; not all learners will accumulate these skills in the same order or pace so flexible delivery, perhaps learner-led, is a useful option.

Conducting live demonstrations is a sensible way to introduce new techniques, but there is undeniably some advantage in advocating a rotating pilot/navigator-style arrangement, with learners taking time in supporting their peers' development. Using video tutorials created by other learners affords another fun and totally different alternative to formal instruction.

Naturally, you should formatively assess these skills through in-class activities and/or homework tasks before summarily assessing. Short and sharp testing works well here and may be suitable as a session's lead activity.

You may use a similar approach for 3D graphic tools, although this type of software is notoriously more complex in terms of understanding the user interface and remembering the typically complex mouse/key combinations required, so some mild caution is advised.

In addition, abbreviations and acronyms can be somewhat obtuse, for example, NURBS (non-uniform rational basis spline) and initially confusing for learners with weaker mathematics skills. For these reasons, additional in-class support and guidance is often required, particularly when working with more complex models and meshes or where learners have conceptualisation issues.

A suggested generic approach could be:

- Select a new model/image to create.

- Introduce new tool or technique that is required to create the new model/image.

- Demonstrate the tool/technique to learners.

- Ask learners to practise tool/technique.

- Allow learners to upload their resulting efforts to a class-accessible gallery.

- Moderate peer critique on each learner's effort.

- Record helpful tips collected by learners when using the tool/technique.

The use of lunchtime clubs for 3D modelling can be a useful option for reinforcement and encouraging self-study.

Unless the offer is available in-house, you could also investigate whether a representative from an approved training provider delivering specific vendor-oriented study programmes could visit and provide information about the courses and certification (particularly as some learners may opt to study such a qualification alongside or after completion of this course). Similarly, competency of sound and video editing skills should also be stressed.

Learners should become adept at reviewing both their own efforts and those of their peers, typically through verbal critique and written feedback. You should encourage learners to benchmark their digital products against the client's requirements (the original brief), the overall quality of the image/model, any pertinent constraints (legal/ethical or technical, e.g. formats, frame rates, resolutions) and the level of optimisation that have been applied. You should expect learners to use technical terms correctly during the provision of feedback. Do not forget to tease other judgements about the digital animation and effects from the learners, including its perceived strengths, weaknesses and how it can be improved (from a technical standpoint and in order to correctly fulfil the client brief).

Evaluation and review benefits from repeated exposure; learners may be initially reluctant to give critical feedback in a constructive fashion. However, after routinely repeating the process at the end of a practical task, it soon becomes an intrinsic, normal and rewarding part of the learning process, demonstrating professionalism in their work. Some practitioners may feel inclined to incentivise, promoting 'Digital Animation Artist of the week' awards to recognise exceptional performance, for example.

The final part of this learning aim continues this theme and requires the learners to self-assess their progress in the unit. You should encourage focus on aspects such as timekeeping (vitally important in the media industry for those hoping to progress further), actively responding to feedback, supporting others and measuring progress towards set goals. The issue of individual lesson plans (ILPs), with session or weekly targets can be a useful vehicle to chart performance across a defined period for both you and the learner, providing a handy repository that to draw upon. Revisiting the skills and behaviour audit completed at the start of the unit is also highly recommended.

## Assessment model (in internally assessed units)

| Learning aim | Key content areas | Recommended assessment approach |
|---|---|---|
| **A** Investigate the purpose and characteristics of digital animations and effects that are an important part of communication | **A1** Purpose of and legal requirements for digital animations and effects<br><br>**A2** Techniques for and principles of creating digital animations<br><br>**A3** Principles of creating digital effects<br><br>**A4** Hardware and software tools for digital animations and effects | A report on the purpose and characteristics of digital animation and effects products, including how the technical characteristics impact on the product<br><br>The characteristics include: legal requirements, animation and effects principles, and hardware and software tools used to create the digital products. |
| **B** Design a digital animation and effects product to meet a client brief | **B1** Planning products incorporating digital animations and effects<br><br>**B2** Design documentation for digital animations and effects products<br><br>**B3** Reviewing and refining designs for animations and effects | A design specification showing the planning and design of an animation and effects product that could be used in a larger media product<br><br>Digital animations and effects files that fulfil the design specifications, accompanied by supporting development and testing documentation<br><br>An evaluation of the digital animation and effects product against the client's brief. The product may be developed for inclusion in a larger media product, such as a computer game.<br><br>A record of personal performance while completing the activity such as whether work was submitted on time |
| **C** Develop a digital animation and effects product to meet a client brief | **C1** Tools and techniques for digital animations and effects<br><br>**C2** Creating a digital animation and effects product<br><br>**C3** Testing animations and effects<br><br>**C4** Reviewing the final digital animation and effect product<br><br>**C5** Professional behaviours | |

## Assessment guidance

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

### Assignment 1 (learning aim A)

A thoroughly researched report, digital animation magazine-style article or learner-led presentation, focussing on of how the characteristics of the animation and effects products, impact on their purpose, usability and accuracy. Learners' enquiries will lead to a supported judgement, showing relationship to its context.

Offering learners a choice of presentation medium for their evidence will often encourage individual thinking and allow them to embrace the various possibilities presented by the medium chosen, for example, integrating interactive 3D assets into their presentation or including specifically created 2D art in a magazine article.

Things to remember to offer the best opportunity for learner success:

- Learners must include coverage of the different types of digital graphic products (both 2D and 3D), using technical language accurately in their descriptions. Comparison of different 2D formats, i.e. raster versus vector-based is essential, demonstrating a firm understanding of how this relates to file formats, scaling accuracy and resolution.

- Learners should identify typical uses of animations and digital effects (e.g. video game assets) and their purpose (entertaining users). Learners that are more able should be able to make links between the underlying need for animation and effects and how they can be achieved most effectively.

- Learners should explain the purpose and legal considerations when creating digital animations and effects.

- If the report format is selected, it would ideally follow a recognised format (either formal or informal) and should be presented as a professional business document, with consistent use of correct grammar and spelling, and correct referencing of information sources.

- Access to appropriate hardware, software and tutorials is required in order for learners to create bespoke images or customise existing ones.

- Learners will need to access a range of both published and online sources to provide the academic content.

- Learners should develop there evaluation skills through clearly identifying the strengths and weaknesses in their work, as well as how their work clearly meets the brief. This should not simply be descriptive.

### Assignment 2 (learning aims B and C)

Ideally, you could link this assignment with other units to form part of an integrative assignment. Examples could include building assets (animations, presentations, videos etc) for a customer's website, creating graphics and sound effects for an interactive game or assets for use in a mobile app.

Alternatively, the use of a 'live' industry brief from a sponsor or mentor can provide fertile ground for creative efforts. Where possible, it should include hidden learning that can support progress in other units and afford some inter-curricula links.

The task must involve the design and creation of digital animation and effect assets that should be fit for a given purpose.

Things to remember to offer the best opportunity for learner success:

- Learners should demonstrate evidence of research that is pertinent to the client brief, generating a range of potential designs for each digit product required. Learner notes that justify their decisions through a clear understanding of core digital animation and effects design principles, the intended audience and purpose should accompany each design.

- Once final designs have been selected, these should be developed using appropriate hardware and software tools. Expect the learner to document each part of creation
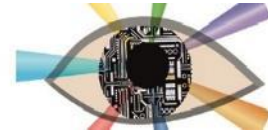
process, providing detailed explanation of the tools and techniques used with a rationale.

- Completed digital images need to be evaluated and optimised by the learner drawing upon the technical standard of the final product, the range of techniques used and how closely they have resolved the client's requirements.

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

- Access to appropriate hardware, software and tutorials is required in order for learners to create bespoke images or customise existing ones.

- Learners will need to access a range of both published and online sources to provide the academic content.

# Getting started

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

| Unit 18: Digital Animation and Effects |
| --- |

**Introduction**

Introduce this unit by ascertaining the learners' experience with digital animations and effects (most will be limited to 2D products) and detail the full expectation of the unit's outcomes and the skills (and professional behaviours) the learners will develop before its completion.

Use of previous cohorts' work (if available) is a very useful touchstone for new learners, especially if they compare favourably with commercial examples, as they will inspire and provide realistic targets to which they may aspire. Providing examples of well-known examples of digital animations and effects is a sound tactic, especially if culled from popular media, such as film, TV, advertisements and video games.

You may consider measuring initial learner skills by using a simple skills and behaviours audit, permitting the creation of individualised starting points based on prior experience. This would help you manage practical sessions more appropriately, spending limited support time in the most efficient manner. Repeat this process at the end of the unit using the same document to measure distance travelled.

You may also consider appointing (or asking for volunteer) learners with more experience to act as classroom support.

**Learning aim A – Investigate the purpose and characteristics of digital animations and effects that are an important part of communication**
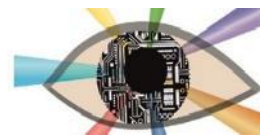
**Learning aim A1 – Purpose of and legal requirements for digital animations and effects**

You will detail the purpose and legal requirements of digital animations and effects. Legal requirements are limited to UK legislation, although encouraging a wider geographic awareness in learners is recommended. This learning aim A1 should take approximately 4 hours.

- Define the key purposes of digital animations and effects:
  - o conveying information, messages and meaning to a target audience
  - o visualise, communicate, verify and evaluate potential ideas to a target audience.

  Use of case studies can be particularly helpful here, particularly mixing examples that have been successful and those that have not (for contrast). Common examples could include TV advertisements, video game cut-scenes, film trailers, multimedia advertising campaigns etc, particularly where a change of artistic direction can be evidenced. These types of activities often provide opportunities for open group discussion on the merits (and otherwise) of the digital animations and effects created and how they were used (and their effectiveness and impact on the target market/audience). Practical activities such as market research are a possibility.

- Present the current and relevant UK legal requirements for digital animations and effects:
  - o This should minimally include those covering defamation, licensing requirements, copyright, designs and patents. Particular emphasis should be

placed on the adapting of digital animations and effects, including derivative use.

o Generate learner-driven group or round-table discussion using relevant case studies.

o The use of classroom 'courts' with learners role playing the various parts (defendant, prosecution, defence, jury, expert witnesses) and you as the Judge can be particularly effective when paired with the legal frameworks relevant to this subject (see specification for recommended list).

## Learning aim A2 – Techniques for and principles of creating digital animations

You will lead learners through the different animation techniques commonly used.

This learning aim A2 should take approximately 8 hours.

- Demonstrate basic frame-by-frame animation using commercial software, encouraging learners to note new terms they encounter. Task learners with building a basic frame-by-frame animation of their own choice, e.g. using traditional animation, live action, rotoscoping techniques.

- Learners could investigate and document the differences between vector and raster animation, comparing and contrasting their advantages and disadvantages.

- Learners to investigate and document different file formats available, comparing and contrasting their advantages and disadvantages.

- Demonstrate basic 3D modelling techniques, including basic vector shapes and different texture methods. Introduce the coordinate system, object hierarchy and pivot points used for rotation and scaling.

- Demonstrate animation trajectories for creating, adjusting and converting motion paths for 3D objects.

- Differentiate inverse and forward kinematics and provide commercial examples (video game footage provides a rich source for this).

- Demonstrate the use of animation layers in 3D workflows and how simple morphing effects can be achieved.

- Lead practical learner mini-workshops for practical 2D and 3D animation. Set discrete tasks with ascending orders of technical difficulty to set suitable stretch and challenge targets for learners. Learners should work individually but some tasks reward a pair-based pilot/navigator-style approach to problem solving.

## Learning aim A3 – Principles of creating digital effects

You will present, demonstrate (where possible) and discuss the basic principles of creating digital effects (visual and audio).

- For visual effects:

  o motion tracking, including tracking the movement of objects and applying tracking

  o data to other objects

  o motion capture, including recording movement and actions, 3D recreation

  o performance capture

  o compositing, including live action, animated, background

  o animated effects

  o augmented reality, e.g. video games, navigation devices, architecture

- o virtual reality, including virtual reality games and experiences, e.g. museum tours.

- Many examples of motion tracking and captures can be found on popular video-sharing websites, particularly those that document the creation of computer-generated characters in films and video games. Many mobile devices support the use of augmented reality, both in terms of applications and simple creation suites. Virtual reality headsets and development kits are available for a multitude of devices, including smartphones, PCs and various video game consoles, often with educational discounts.

- For audio effects:

  - o synchronising audio, including lip-synching, onscreen movement, actions

  - o mixing sound, including levels, normalisation, equalisation, e.g. peak, high shelf, low shelf, high pass, low pass

  - o compressing sound recordings, e.g. remove flawed, repetitive, superfluous audio material

  - o combining sound effects, atmospheric/ambient sound, music and dialogue.

- Discuss the impact of visual and audio effects principles on the usability and accuracy of digital animation and effects. Using suitable examples, task learners with comparing file formats, sound consistency, colour combinations and user engagement.

### Learning aim A4 – Hardware and software tools for digital animations and effects

You will establish the range of software and hardware tools commonly used in the development of 2D and 3D digital animations and effects, specifically those that capture, processing images internally, noting the impact on development and the finished product. This learning aim A4 should take approximately 5 hours, but it is possible to amortize some time from combining with Unit 1's Assessment Outcome area A1 – Digital devices, their functions and use.

- Lead a practical session to capture, process and output digital images using digital devices. Personalisation will allow learners to capture images from their own smartphone cameras. Explain the role of the internal hardware components in image storage and processing, e.g. graphics card, random-access memory (RAM), high-speed cache and central processing unit (CPU).

- Learners should also make some (introductory) practical use of different types of software applications to manage and manipulate the images they have captured, e.g. 2D/3D animation editors, audio/visual effect editors and file conversion tools. At the point, learners should be expected to identify the range of commercial software available and describe their purpose, functionality and features. These categorisations need to be goal-based; learners need to know which software product will help them to complete a particular task, e.g. adding computer-generated effects to pre-existing video footage.

- Demonstrate, compare and contrast the impact that hardware and software tool selection has on the usability and accuracy of digital animation and effects. Using suitable examples, task learners with comparing output formats, rendering times, image resolution, frame rates, output size, aspect ratio and the optimisation of colour depth.

### Learning aim B – Design a digital animation and effects product to meet a client brief

### Learning aim B1 – Planning products incorporating digital animations and
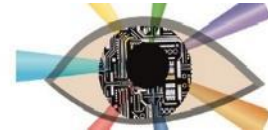
**effects**

Lead class discussion that encourages learners to think about the processes and techniques to consider when planning the production of digital animations and effects. This learning aim B1 should take approximately 3 hours.

- Issue learners with a client brief from a suitable case study.

- Ask learners to consider the source of the specification.

- Explore different techniques for generating ideas, e.g. brainstorming, presenting ideas using mood boards, storyboards and thumbnail sketches.

- Discuss the technical (rather than aesthetic) characteristics that define an image's inherent quality, e.g. quality and compatibility.

- Ask learners to provide an overview of the different processing and editing techniques that they think would be required to produce the target image.

- Discuss the various file and compression formats, selecting (with justification) the most appropriate for the task.

**Learning aim B2 – Design documentation for digital animations and effects products**

You will detail the documentation that learners need to generate for their digital animations and effects designs. This learning aim B2 should take approximately 5 hours.

- Walking learners through a model set of documentation produced for a client brief is a good starting point. The leveraging of previously completed learner work is often very illuminating and can help set the bar for new learners.

- Demonstrate the different elements that form part of the design's documentation, e.g. client brief, research, market research, technique planning, themes and aesthetics, legal and ethical considerations, reference imagery, mood board, spider diagram design sketches, readymade assets used.

- Demonstrate concepts such as key frames, timing, frame identification (numbering or naming), frame rate (frame consumption and smoothness of animation), dope sheets and long sheets etc.

- Provide guidelines for documentation elements, such as hardware and software requirements, specifically those required for capturing, creating or modifying animation and effect assets.

- Discuss legal and ethical requirements that should be included, e.g. copyright acknowledgements/notices, release forms and considerations of ethical, representational and decency issues. Try to cover these by highlighting bad examples where such issues had not been considered thoroughly and the resulting product has received legal, public or critical backlash.

- Encourage learners to consider and discuss technical constraints that may limit the product potential.

- Using a sample client brief, allow learners to problem solve and design a solution within a set time limit after which they can then present their efforts. In terms of formative assessment, focus on the presence, depth and range of the documentation elements produced more than the actual quality of designs (for now, as these will almost certainly improve through the programme).

**Learning aim B3 – Reviewing and refining designs for digital animations and effects**

Help learners to review and refine their designs by introducing learners to the process

of working with clients and others to improve their quality, effectiveness and appropriateness. This learning aim B3 should take approximately 5 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, personal interview. Remember to place additional emphasis on non-verbal communication, especially when learners are receiving feedback from client.

● 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. Leveraging social media is a good way to engage with SMEs to find suitable learner-friendly client briefs.

● Arrange, moderate and support client/learner role play that aims 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.

## Learning aim C – Develop a digital animation and effects product to meet a client brief

### Learning aim C1 – Tools and techniques for digital animations and effects

You will facilitate the learner's ability to use appropriate tools and techniques to create digital animations and effects. This learning aim C1 should take approximately 20 hours plus additional self-study to hone skills appropriately.

● Introduce each tool and technique specified for digital animations and effects, explaining its purpose and application. If you have time, you may enrich this suggested list.

● Provide instruction and/or written, video, pilot/navigator-style support for each learner as they prefer. Issue an ILP to each learner with individualised targets.

● Monitor and support learners throughout, utilising trustee classroom assistance as necessary.

● Allow learners to upload their resulting efforts to a class-accessible gallery.

● Moderate peer critique on each learner's effort.

● Record helpful tips collected by learners when using the tool/technique.

### Learning aim C2 – Creating a digital animation and effects product

You will detail the desired workflow associated with creating a digital animation and effect products by:

● supporting learners as they create readymade assets that can be used for compositing, i.e. generating the filmed or rendered elements from multiple sources that will be combined to create the desired animation

● demonstrating how to import readymade assets into a project

● discussing the correct management of original and readymade assets

● demonstrating how layers and assets can be combined together to create an effect

● revealing how visual and audio effects can be added to enhance the product.
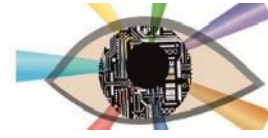
● using a mini-project as a vehicle for this type of activity, tasking learners with working on a narrowly defined client brief that enables them to be shepherded through the correct workflow with a minimum of technical differentiation. Sessions are likely to be highly practical in nature, with learners perhaps working in pairs or small groups depending on the complexity of the task and the resources available. Supporting resources such as handouts, video tutorials and classroom technicians may be beneficial.

## Learning aim C3 – Testing animations and effects

You will detail the testing of digital animations and effects by:

● demonstrating to learners how digital animations and effects are tested. Differentiate testing techniques used to assess functionality, compatibility, stability and acceptance.

● introducing the practicalities of testing digital products against the client brief, especially with regard to target audience and specific purpose. A useful technique is to place the learners in the position of giving constructive feedback to a sample animation and/or effect and collecting their responses using different feedback mechanisms.

● discussing techniques for obtaining useful feedback from others, e.g. focus group, questionnaire, interactive polling, directed question and answer, email, website survey. Identify relative advantages and disadvantages for each technique and use this to openly debate which feedback collection technique may be most effective (and why).

● showing how animations and effects can be improved in response to testing and feedback, e.g. critique from others helping to identify unconvincing or rough elements in an animation, which could be smoothed out or edited more tightly to achieve a better standard.

## Learning aim C4 – Reviewing the final digital animation and effect product

You will lead and moderate reviews of final digital animations and effects by the learner, learner peers, their clients and other interested parties. This learning aim C4 should take approximately 3 hours.

● Learners produce an electronic gallery of their digital animations and visual/audio effects work.

● Invite open critique from learner peers, clients and other stakeholders.

● Incentivise, promoting 'Digital Animator of the week' awards (or real prizes) to recognise exceptional performance, for example.

● Learner should personally review each digital animation and visual effect they have created using the recommended checklist (see specification) and feedback from others.

● Encourage learners to consider legal and ethical requirements and the technical constraints that have influenced each product.

● Learner should recommend improvements that could be made, e.g. from acknowledging strengths, weaknesses and opportunities for optimisation.

● Ideally, place selected learner work on display at key locations around the institution and organise a retrospective exhibition of the best work at the end of the programme.

● Where possible and permissible, keep copies of a range of learner work to use with the next cohort.

## Learning aim C5 – Professional behaviours

Help learners to reassess their professional behaviours. This learning aim C5 should take approximately 2 hours.

- You should now reissue the skills and behaviours audit completed by learners in the first session so that they can now revisit the document and make additional observations about where and how they feel they have improved. Learners may also find it useful to reference their ILPs when completing this task.

- Learners should use the internet (or the centre's own learning centre resources if any exist) and identify sources such as videos or other materials that would help them to improve the skills they identified as needing improvement. A combined list of resources from all learners should be published and/or shared by the class.

- Specific skills development opportunities include:

  o Project planning: Over the course of the unit, learners provide evidence by planning and developing a project to a set brief.

  o Communication: During set client and peer reviews, learners are presented with opportunity to develop and evidence their communication skills – this could also be developed electronically.

  o Teamworking: Several in-class exercises (such as developing planning documentation to a client brief) could be developed throughout the unit.
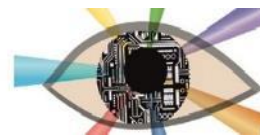
## Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Depending on the choice of project, the following units will provide useful underpinning knowledge and skills that can be drawn on to create the deliverables:

- Unit 1: Information Technology Systems
- Unit 3: Using Social Media in Business
- Unit 4: Programming
- Unit 6: Website Development
- Unit 7: Mobile Apps Development
- Unit 8: Computer Games Development
- Unit 15: Customising and Integrating Applications
- Unit 17: Digital 2D and 3D Graphics

## Resources

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

### Textbooks

Blain JM, *The Complete Guide to Blender Graphics* (3rd Edition), CRC Press, 2016 ISBN 9781498746458 – delving deeper into the process of creating 3D models in Blender

Brinkman R, *The Art and Science of Digital Compositing: Techniques for Visual Effects, Animation and Motion Graphics* (2nd Edition), Morgan Kaufmann, 2008 ISBN 9780123706386 – case studies of digital compositing work performed in popular films

Derakhshani D, *Introducing Autodesk Maya 2016*, John Wiley & Sons, 2015 ISBN 9781118862841 – introductory text with good examples of working with industry-popular 3D software

Faulkner A and Gyncild B, *Adobe Photoshop CC Classroom in a Book (2014 Release)*, Adobe Press, ISBN 9780134308135 – a primer for working with raster images using industry-standard software

Fridsma L and Gyncild B, *Adobe After Effects CC Classroom in a Book 2017* (Pap/Psc edition), Adobe, 2017 ISBN 9780134665320 – step-by-step introduction to the popular digital visual effects and compositing application

van Gumster J, *Blender For Dummies*, John Wiley & Sons, 2015 ISBN 9781119039532 – getting started building 3D models in Blender; assumes no prior experience

Jago M, *Adobe Premiere Pro CC Classroom in a Book (2017 Release)*, Adobe, 2017 ISBN 9780134665313 – step-by-step guide to the popular video editing and mixing application

Schroder C, *The Book of Audacity*, No Starch Press, 2011 ISBN 9781593272708 – guide to the cross-platform audio editor which demystifies its technical jargon

Wright S, *Digital Compositing for Film and Video*, Focal Press, 2010 ISBN 9780240813097 – tips, techniques, and solutions for dealing with commonly faced compositing obstacles

**Journals**

*3D World Magazine* – http://www.creativebloq.com/3d-world-magazine

*Animation Magazine* – http://www.animationmagazine.net/

*Computer Arts Magazine* – http://www.creativebloq.com/computer-arts-magazine

*Computer Graphics World* – http://www.cgw.com/Publications/Current-Issue.aspx

*ImagineFX Magazine* – http://www.creativebloq.com/imaginefx

**Videos**

Adobe Photoshop Tutorials (https://www.youtube.com/user/NewWorldOps)

The Best Adobe Premiere Pro Quick Tips (https://www.youtube.com/user/BPAQuickTips)

Blender 2.7 Tutorial series
(https://www.youtube.com/playlist?list=PLda3VoSoc_TR7X7wfblBGiRz-bvhKpGkS)

Blender Guru series (https://www.youtube.com/channel/UCOKHwx1VCdgnxwbjyb9Iu1g)

Free Audacity Tutorials (https://www.youtube.com/user/FreeAudacityTutorial/playlists)

Maya How Tos (https://www.youtube.com/user/MayaHowTos)

**Websites**

http://www.adobe.com/products/aftereffects.html – Adobe After Effects – A digital visual effects, motion graphics, and compositing software application

http://www.adobe.com/products/premiere.html – Adobe Premier Pro – A timeline-based video editing software application

http://www.audacityteam.org/ – Audacity – A free, easy-to-use, multi-platform multi-track audio editor and recorder

http://www.autodesk.co.uk/products/maya/overview – Autodesk Maya 3D – Professional 3D computer modelling and animation software

https://www.blender.org/ – Open Source 3D creation suite – Free downloads, FAQ, user community, user galleries and tutorials

https://creativeskillset.org/ – Creative Skillset – Works with the UK's screen-based creative industries to develop skills and talent, from classroom to boardroom, supplying advice, industry news, information on courses and job roles

*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.*

# Unit 19: The Internet of Things

## Delivery guidance

This is an optional, internally assessed unit that provides an opportunity for learners to consider the wider implications of IT and how it impacts on the world.

The Internet of Things (IoT) has become a market-changing tool for retailers, service providers, consumer electronics OEMs and system integrators enabling new products and services, delivering new revenue streams, operational efficiencies and improved customer engagement models by providing a new method of interconnectivity between people, and the devices and services they use.

Conservative estimates claim that by 2020 there will be:

- 4 billion connected people
- $4 trillion revenue opportunities
- 25+ million apps
- 26+ billion embedded and intelligent systems
- 50 trillion GBs of data.

This unit allows learners to investigate the applications of different IoT systems and services to different sectors. They will develop a design for an IoT system or device to solve a problem, and will develop a prototype of an integrated IoT system or device to solve a problem.

There will be many opportunities for research and for learners to explore how the IoT is relevant to their everyday lives and to areas of personal interest.

The IoT relies on four core skills:
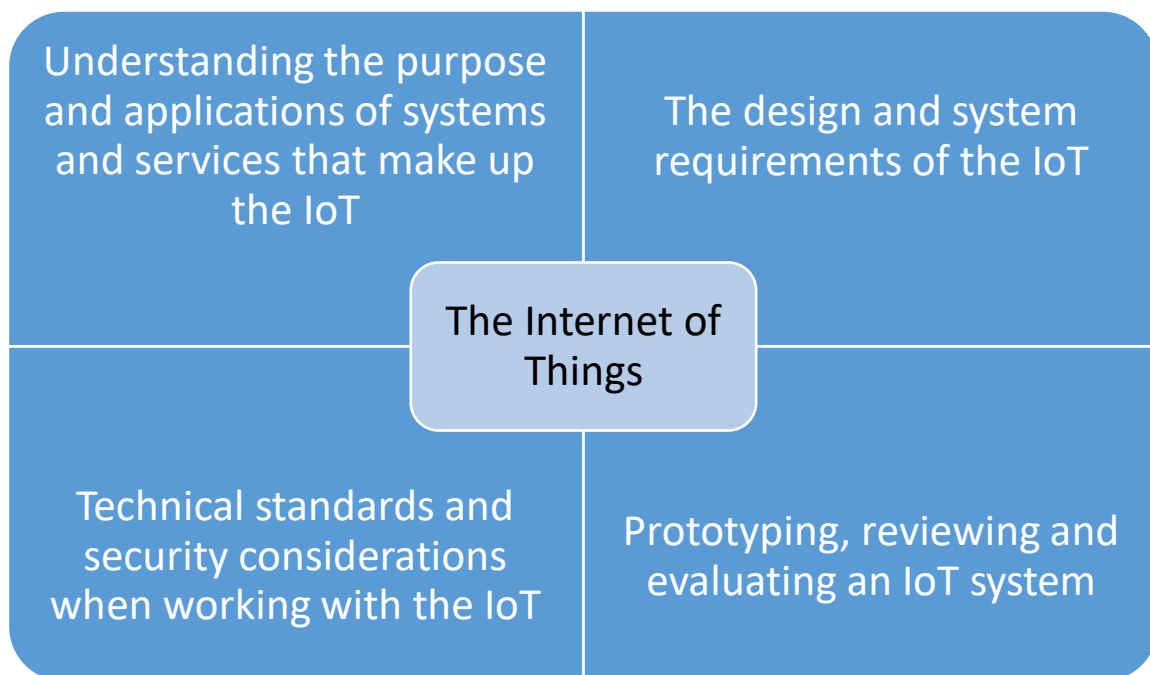
## Approaching the unit

This unit has an element of theoretical content, highlighting the underpinning purpose, principles and characteristics of this new IoT technology, as well as how and why it reaches so many different industries and sectors. Learners should have the opportunity to explore the net to consider what is currently available, and some of the emerging IoT technologies (e.g. nanotechnology (nanosensors and the Internet of Nanothings), autonomous vehicles, optogenics) and, further forward, systems to improve customer interactions and the customer experience as well as further developments for augmented reality.

Having considered the how and why of the IoT, learners will then design and prototype for the IoT.

### The approach to this unit should be:

- As practical as possible to give learners an opportunity to gain a range of IoT-related design and development skills. This should be done by giving learners ample opportunity to engage with IoT technologies. Learners should learn practical logic skills from sites such as IFTTT, which teaches the basic principles of IoT development.

- You should use the internet to gather a good range of contexts against which to pitch the learning. Demonstrations are key here to show how the IoT genuinely impacts on people's lives.

- Security and ethical considerations give ample opportunity for learners to carry out independent research into the impacts of these technologies.

## Delivering the learning aims

### Learning aim A

This aim provides the underpinning content for the IoT and the benefits of this new technology in the real world. Learners will begin by developing an understanding of the purpose of systems, the services they provide (such as device monitoring and management, security, tracking, remote maintenance, meterin) as well as the contexts in which the IoT operates.

They will look at the principles of common IoT services, such as the collection and analysis of data that is triggered by actions – the common principles include product/service operations, the collection and analysis of data and systems monitoring.

To complete this learning aim, learners will explore the regulatory and ethical characteristics of IoT systems and services (such as risks and security, ethical and privacy considerations, the law, sustainability and benefits) before examining the technical characteristics of IoT systems and services.

### Learning aim B

As a practical learning aim, learners will need to develop a design for an IoT system or device to solve a problem. There are similarities here with aspects of systems analysis and program development, such as investigation, outlining requirements and developing initial designs and/or prototypes, with the usual diagramming and supporting text that learners may well have experienced before.

As the IoT frequently has no user/physical intervention and is made up of machines connecting to other machines and systems, learners explore the architectures and

communications requirements, including sensors, wireless and wired communications, and actuators (used in controllers, motors and servos).

An appreciation of the concept that the IoT is built on three domains (device, network and application) will enable learners to learn how connected networks enable communications between machines, acting as gateways.

Technical standards are important and some of the organisations involved in setting standards and monitoring activity are considered. One key question that would provide a useful discussion could be 'what would happen if there were no standards and no gatekeepers?'

The final part of this learning aim is focused on security of IoT systems and devices and asks learners to examine not only the threats posed to unmanned and unguarded systems and devices, but the importance of remote management, and the implementation and use of security protection methods.

Having taken these factors into account, learners will draw on their knowledge and understanding to develop a design for a device or system with illustrations outlining the architecture, communication requirements, addresses and security protection methods, and they will demonstrate a consideration of alternative solutions.

## Learning aim C

In this final learning aim, the learners will develop a prototype to solve a problem identified for an integrated IoT system or device.

To do this, they need to understand how the machines work together, how to manage the interconnected devices ensuring that these are kept up to date and how rule-based event triggers enable the execution of smart actions based on sensor events.

Programming techniques and constructs will be lightly relevant here, although this learning aim focuses more directly on the development of a simplistic prototype for an IoT solution. There will also be a requirement for working with basic logic, which is a fundamental component of the IoT, for example, If This Then That design solutions (if user approaches shop, ping shopping list).

The learning aim completes with an investigation into IoT analytics – how IoT data are used in various contexts.

Learners will be able to develop a prototype IoT system or device, evidencing their activity with screen grabs, videos, photos and reports for the raw data collected and for the results of processing and analysing the data.

## Assessment model (in internally assessed units)

| Learning aim | Key content areas | Recommended assessment approach |
|---|---|---|
| **A** Examine systems and services that form part of the Internet of Things | **A1** Purpose and applications of systems and services that make up the IoT<br><br>**A2** Principles that underpin IoT systems and services<br><br>**A3** Characteristics of systems and services that make up the IoT | A written or video report investigating the systems and services that make up the IoT. Learners will cover the purpose, applications, principles and characteristics of systems and service that make up the IoT |
| **B** Develop a design for an Internet of Things system or device to solve a problem | **B1** IoT system or device design process and documentation<br><br>**B2** Machine-to-machine (M2M) system and device architecture<br><br>**B3** Technical standards for IoT systems and devices<br><br>**B4** M2M system and device communication requirements<br><br>**B5** Security of IoT systems and devices | A system or device design portfolio containing the annotation and illustration of the architecture, communication requirements, addresses and security protection measures, including a comparison of alternative solutions<br><br>The development of a prototype IoT system or device with screen grabs, videos, photos and reports for the raw data collected and the results of processing and analysis of the data |
| **C** Carry out the prototyping of an integrated Internet of Things system or device to solve a problem | **C1** M2M integrated system or device operations<br><br>**C2** Programming techniques and constructs<br><br>**C3** IoT analytics | |

## Assessment guidance

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

### Assignment 1 (learning aim A)

Developed as a written or video report, learners investigate the systems and services that make up the IoT. They should describe the purpose and applications of IoT systems in different sectors, going on to explain the principles and characteristics of systems and services in at least two sectors.

Learners should compare the purpose and applications of at least four devices from at least two different sectors. The comparisons should focus on the principles and characteristics from both a technical and general perspective.

**Assignment 2 (learning aims B and C)**

Learners should create a design for a system or device ensuring that it meets principles and standards as studied. Designs should be annotated with feedback sought from others, outlining improvements that could be made during the implementation stage. The prototype can be created using any appropriate off-the-shelf hardware and a suitable language. With partial functionality, the learners should be able to explain how the solution would solve the problem.

Learners will be expected to use appropriate technical language.

For the higher grades learners will need to justify their design decisions and show how they have incorporated feedback.

The prototype should be functional, at least in part.

# Getting started

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

## Unit 20: The Internet of Things

### Introduction

This unit is highly practical in that learners design and create a prototype for an IoT system or service. To do this, they have to develop an appreciation of IoT as a concept, and be able to identify sectors where IoT already exists, extrapolating to potential new opportunities.

As a current area of growth, there will be increasing opportunities for jobs in this area.

### Learning aim A – Examine systems and services that form part of the Internet of Things

### Learning aim A1 – Purpose and applications of systems and services that make up the IoT

**What is the purpose and application of the systems and services that make up the IoT?**

- Lead a discussion that draws out learners' own knowledge and experience of IoT and how it affects their lives (in their place of education or in the home). There are four areas in the specification that you can use as a focus for the discussion - productivity, safety and security, efficiency and effectiveness and finally the experience and satisfaction of users. Learners should be able to give real examples of where they have come into contact with the IoT. There are also many examples on the internet that you could use to illustrate these four areas.

- Present examples of IoT systems and services in different sector contexts. A number of the videos listed in the Video Resources section at the end of this guide give examples that will be useful and which could be hyperlinked into a presentation.

### Learning aim A2 – Principles that underpin IoT systems and services

**What are the principles that underpin common IoT systems and services?**

- Learners research how the IoT collects and analyses data that triggers actions to meet a particular need or solve a problem, e.g. climatically controlled greenhouses: using sensors to gather data on a range of variables and making rule-based decisions on actions that will be taken. Data are then stored and outputs (growth yields/harvest) measured in relation to the controls in the environment to improve efficiency and effectiveness of the environment. Learners should be able to give examples of other situations during a class discussion (in transport, health, entertainment and retail – among others).

- Present on the role of the existing internet and telecommunications infrastructure plays in supporting the IoT systems and services, with examples, along with the access to and or analysis of both real-time data and analogue data from the physical and natural world.

- Lead a discussion on the always-on connectivity that allows continuous monitoring of data from the physical world; this can be developed into a discussion about the general principles of 24/7 availability.

- Present on The Spectrum of Insight (slides 6 and 7 in the websites listed in the Resources section of this guide).

## Learning aim A3 – Characteristics of systems and services that make up the IoT

**What are the general and technical characteristics of IoT systems and services?**

- Split the class into two halves and then sub-divide the learners into small groups of 3 or 4. Allocate each group of learners either 'general' or 'technical' and then one of the following:

  A. Presentation

  B. Web page

  C. Quiz

  D. Animation/video

  E. Technical 250--300 word article.

- Learners should then be given a list of the sub-items in the general or technical category and should work in their groups to create whichever artefact they have been given. You can change the items in the artefact list to include some of your own if you wish.

- Learners should be encouraged to evaluate the purpose and characteristics of these different devices (assessment criteria A3)

- All learners take part in reviewing each other's artefacts.

## Learning aim B – Develop a design for an Internet of Things system or device to solve a problem

### Learning aim B1 – IoT system or device design process and documentation

**What are the steps involved in developing a design for an IoT system or device to solve a problem?**

- Deliver a presentation that covers the steps involved in investigating for design of an IoT system including:
  o problem definition statement
  o purpose requirements
  o initial design ideas.

  Learners should consider areas of a business model, such as the problem, existing alternatives, solutions, key metrics, unique value propositions and high level concept, unfair advantage, channels, customer segment and early adopters, as well as cost structure and revenue streams.

  It is highly likely that this will need to be a revision session only based on the fact that learners will have met the same concepts in different contexts/units.

- Issue a scenario for learners to work with, or create an outline for the tasks and allow them to choose their own context. When learners undertake the assignment, they will be working on a potential innovation (or new way of doing something). For this activity, they can replicate something that exists already – it is the process that is important here not the product.

  Learners should work in small groups to go through an investigation and initial design. They will use the same context in the next topic.

### Learning aim B2 – Machine-to-machine (M2M) system and device architecture

**What is the architecture of M2M communications in IoT systems and devices?**

- Learners should work in pairs to explore the components and domains described in the unit content, e.g. sensors, connectivity, platform, analytics, user interface. In groups, learners could be given a range of IoT scenarios with different architecture and communication requirements. Each group can come up with a design solution and present to the class; this will give the class a broad overview of the implementation possibilities for different scenarios. This activity could also incorporate features/span over LA B3 and B4 also.

- Working with the design created for the previous topic, learners should now work in the same groups to establish which architecture they would use to implement their IoT system or service.

  They should create a technical specification/outline of their system or service and present it informally to a member of the technical staff in the department to check it for appropriateness.

**Learning aim B3 – Technical standards for IoT systems and devices**

**What are the current and relevant industry and internet standards that are set out by standards organisations?**

- The specification lists three organisations (ISO, LoRa Alliance and IEEE), with a number of standards and reference frameworks relevant to the IoT. Give learners a table to capture research they will undertake individually or in pairs. The three homepages for these organisations are included in the websites in the Resources section at the back of this guide. The column headings should read:

  o Organisation

  o Purpose

  o Standard or Reference framework

  o Description and scope of standard.

- Deliver a presentation to learners that covers these topics, which will enable them to add anything they missed.

- Working with the design and technical specification created with the previous topic, learners should check their design and specification for adherence to the listed standards.

- Lead a class discussion to check and explore any anomalies.

**Learning aim B4 – M2M system and device communication requirements**

- Learners work together in small groups to investigate the content for a series of three linked webpages - one for each of the following:

  o system and device communication principles

  o system and device capabilities

  o the identification and network location of secure connected components to support the design of a scalable and efficient system and devices.

- Working together, learners design the content for these pages and storyboard their plans. They can find suitable web content or YouTube videos, news articles or any other relevant data that will help them fill the space.

- Once the designs are completed, learners informally present their ideas to the class for feedback.

- Continuing the earlier group work, learners should identify the system and device

communication requirements for the scenario they have been working on.

### Learning aim B5 – Security of IoT systems and devices

- Drawing on security content from other units, learners should carry out research in pairs that will enable them to create a briefing document as if they were advising a small business client on the security of IoT systems and devices. The briefing document could be a short report, slide presentation or a leaflet.

- Given a scenario, learners should develop a suitable design solution and measure these against the scenario to provide a basis for justification.

- Learners should share their documents with an external specialist who will review them from a technical perspective and give them feedback.

- Continuing the earlier group work, learners should explore their design from a security perspective. Has security been considered? What should be done to make their design secure?

### Learning aim C – Carry out the prototyping of an integrated Internet of Things system or device to solve a problem

### Learning aim C1 – M2M integrated system or device operations

- Prior to carrying out any formal prototyping, a guest speaker should be invited who has experience of M2M integrated systems or device operations who can introduce learners to M2M in a range of contexts. If possible, learners should be able to see some of these systems in action.

- Initiate a Q&A session to give learners the chance to ask questions and seek clarification. They should also use this as an opportunity to talk to a specialist about the system or service they have designed, specifically asking about any pitfalls they may fall into.

- Depending on the context of the scenario they have been working on as a group, learners should begin the prototyping process.

- Given a scenario, learners should develop a suitable design solution and measure these against the scenario to provide a basis for justification.

### Learning aim C2 – Programming techniques and constructs

- Deliver a presentation about programming techniques and constructs. It should include:
  - using a software development environment
  - off-the-shelf hardware devices
  - visual and non-visual programming constructs.

  It is highly likely that this will be a revision session only based on the fact that learners will have met the same concepts in different contexts/units.

- Learners work in their groups to program/develop their prototype and present the prototype to the class once completed. If an invited audience of Year 1 BTEC learners or other staff from the department were available, learners would benefit from having additional feedback. It is likely that this activity will occur over a number of sessions.

### Learning aim C3 – IoT analytics

- Split the class into 3, 6 or 9 groups. Each group should be given one of the following to investigate:
  - extrapolation and prediction

    o   metering and billing

    o   activation of actuators.

Learners collaborate to explore how analytics are used in IoT and create the content for a blog for the class. The content should be uploaded so that it can be shared by the learners.

● Learners should then reflect on which analytics have been used in their prototype and should be able to explain them and justify the approach taken.

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

This unit links to:

- Unit 4: Programming

- Unit 6: Website Development

- Unit 7: Mobile Apps Development

- Unit 8: Computer Games Development

- Unit 9: IT Project Management

- Unit 11: Cyber Security and Incident Management

- Unit 13: Software Testing

- Unit 14: IT Service Delivery

- Unit 15: Customising and Integrating Applications

- Unit 16: Cloud Storage and Collaboration Tools

## Resources

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

**Textbooks**

Bahga A, *Internet of Things: A Hands-On Approach* (1st Edition), VPT, 2014 ISBN 9780996025515 – this book combines both context with technical aspects, and also includes some useful case studies.

Greengard S, *The Internet of Things (MIT Press Essential Knowledge)*, MIT Press, 2015 ISBN 9780262527736 – a non-technical guide that is good for giving the Internet of Things a global and inter-sector context

Kallmereit D, *The Silent Intelligence: The Internet of Things* (1st Edition), DND Ventures LLC, 2013 ISBN 9780989973700 – the most academic of the four books suggested here, which takes a more global approach and contains the opinions of 30 industry veterans, experts and visionaries from companies like Google, Jawbone, Qualcomm, SAP and others

McEwen A and Cassimally H, *Designing the Internet of Things* (1st Edition), John Wiley & Sons, 2013 ISBN 9781118430620 – a more technical book that has a good perspective on prototyping

**Videos**

The Internet of Things: Dr. John Barrett at TEDxCIT (17 minutes) – The observations of Dr John Barrett, Head of Academic Studies at the Nimbus Centre for Embedded Systems Research at Cork Institute of Technology (https://www.youtube.com/watch?v=QaTIt1C5R-M) (poor sound quality for the first two minutes, but is then good quality)

Internet of Things [1/5]: Devices and Local Networks (6 minutes) – The first of a really interesting series of five videos split into key themes. This first video focuses on devices and networks (https://www.youtube.com/watch?v=SDJVFr4VUHA).

Internet of Things [2/5]: Embedded Devices (6 minutes) – The second of five videos, this one focussing on embedded devices (https://www.youtube.com/watch?v=hMPqowfFruo)

Internet of Things [3/5]: Network Protocols and the Internet (6 minutes) – The third of five videos, this one focuses on network protocols and the internet (https://www.youtube.com/watch?v=zveRq0wCSKM&t=8s).

Internet of Things [4/5]: The Cloud (5 minutes) – The fourth of five videos, this one focusing on the cloud, explaining the cloud as a concept (https://www.youtube.com/watch?v=l7wQrSBszNc).

Internet of Things [5/5]: The IoT and the RTOS (6.5 minutes) – The final of five videos that focuses on Real Time Operating Systems (RTOS). It explores the characteristics of RTOS (https://www.youtube.com/watch?v=SmwhrLzVGQw&t=14s)

Internet of Things (IoT) Architecture for Beginners (4 minutes) – Asks searching questions about the future of the IoT and how it will develop (https://www.youtube.com/watch?v=EcWhxb77Gug)

The Internet of Things – An Architectural Foundation and its Protocols (58.5 minutes) – A highly technical webinar from Cisco's Chief Architect for the IoT Group. This contains many diagrams and images that learners will find useful (https://www.youtube.com/watch?v=co2MLqkJVXs).

Top 5 Facts about the Internet of Things (5.5 minutes) – A brief overview of five key aspects of the IoT (https://www.youtube.com/watch?v=c-Ekz2kK7J4)

**Websites**

http://www.computerweekly.com/feature/Internet-of-things-will-drive-forward-lifestyle-innovations – Internet of Things will drive forward lifestyle innovations – an article that gives a perspective for the home and commercial applications of IoT

http://www.computerworlduk.com/galleries/data/12-most-powerful-internet-of-things-companies-3521713/ – 17 most powerful Internet of Things companies 2016: AWS, Microsoft IBM and more – this is in the form of a clickable slide show (although it also carousels on a timer), with supporting text that introduces some of the major players in this area.

https://ec.europa.eu/digital-single-market/en/internet-things – The Internet of Things: Digital Single Market – Europe's IoT Policy published in September 2016.

https://www.ieee.org/index.html – Institute of Electrical and Electronics Engineers – homepage for an organisation consisting of technical professionals who have grouped together to foster technological innovation and excellence for the benefit of humanity

http://www.iiconsortium.org/energy-summit/presentations/IIC_Summit_Keynote_Dr_Tom_Bradicich_June_23_2015.pdf – 7 Principles of the IoT – this presentation covers the more technical aspects of the IoT, with slides 6 and 7 useful for explaining The Spectrum of Insight.

http://internetofthingsagenda.techtarget.com/definition/IoT-security-Internet-of-Things-security – IoT Security (Internet of Things Security) – this link defines IoT security and raises some serious questions, but also has links to a free download called The Developer's Guide to IoT (learners can sign up for this with their email by listing their centre as a corporate entity).

http://www.internetsociety.org/doc/iot-overview – The Internet of Things (IoT): An overview – published by the Internet Society, this 50+ page white paper provides an overview of the IoT and explores related issues and challenges.

http://www.iso.org/iso/home.html – International Organisation for Standardisation – this is the home page for ISO and has a search facility that learners can use to investigate the ISO standards listed in the content.

https://www.lora-alliance.org/ – LoRa Alliance – the homepage for the alliance. It is an open, non-profit association of members that believes the Internet of Things era is now. Initiated by industry leaders with a mission to standardise Low Power Wide Area Networks (LPWAN) being deployed around the world to enable the IoT

https://www.wired.com/insights/2014/11/the-internet-of-things-bigger/ – The Internet of Things is far bigger than anyone realises – an article from Wired that challenges some preconceptions about the IoT. This article talks about a DSM (Digital Single Market) Strategy for Europe post-Brexit. With three tabs, learners can explore articles, access Blogs or can read the latest from the Newsroom.

*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.*

# Unit 20: Enterprise in IT

## Delivery guidance

This unit is a practical unit that develops learners' business, enterprise and entrepreneurship skills. Learners will need to show an understanding of technology as they will choose an idea for a new IT-related product or service. While group work is acceptable during unit development and in class activities, the assessment should be individual.

This is therefore a good unit for the learners to study if they are considering working for themselves. Even if they are not, it will produce useful skills that also overlap into interview techniques.

## Approaching the unit

This unit is essentially learner driven as they will need an idea to develop. They should understand that innovation is not just about creating something new, it could be enhancements to existing products or services, or finding new markets. It could even be a new method of providing a service (such as e-Books or streaming music). Researching recent innovations might help and there are links in the resources to websites that present new ideas in areas such as wearable technologies, software and architecture.

### The approach to this unit should be:

- As practical as possible to give learners an opportunity to develop a range of business, enterprise and entrepreneurship skills.

- Business scenarios should provide a context for activity.

## Delivering the learning aims

### Learning aim A

This aim provides the underpinning theory for the unit by introducing enterprise and entrepreneurship principles and characteristics.

What skills and attributes are needed to be an entrepreneur? What makes enterprises successful? How can technology contribute to a new business idea or innovation?

There are many examples of technological entrepreneurs that learners could research, such as Bill Gates, Azim Premji, Fernando Espuelas, Jack Ma, Mark Zuckerberg, An Wang among others. This learning aim could provide some background reading opportunities.

Learners will undertake a personal skills audit and explore their own skill levels that might, or might not, make them a good candidate for an entrepreneurial venture.

### Learning aim B

Learners carry out group work to investigate an idea for a product or service. They will collaborate throughout the aim, designing prototypes and product or service outlines, and they will consider their target market and the research methods they will use to test the market.

You will need to support learners in undertaking this comprehensively, to ensure good design principles are also applied (drawing on learning from other units), and ensuring that they have considered the available skill set, or a skill set that they can realistically expect to be available.

Carrying out the research and analysing the results will enable learners to test the potential market and provide feedback for them to use to tweak their idea or proposals.

**Learning aim C**

In the final aim, learners will consider two key business planning models – the more traditional and the leaner Business Model or Lean Canvas models. These will be compared so that learners can appreciate their differences.

You could argue that a leaner model is more applicable in today's volatile markets as it will allow greater flexibility and responsiveness that are less possible with the more traditional approach.

Although learners should understand both approaches (traditional and lean), they should focus on only one in the activities.

The outcome culminates in a presentation that will provide a useful opportunity for learners to practise their formal presentation skills before undertaking the final assessment for the unit.

## Assessment model (in internally assessed units)

| Learning aim | Key content areas | Recommended assessment approach |
|---|---|---|
| **A** Explore the nature of enterprise and entrepreneurship in an IT context | **A1** Entrepreneurship and enterprise principles and characteristics<br><br>**A2** Skills audit and teamwork | A video, such as YouTube™, on a successful enterprise and its entrepreneur that considers how the entrepreneur succeeded in building an enterprise that supplied products or services that customers wanted<br><br>A skills self-audit that identifies both entrepreneurial and IT skills, abilities and that considers teamwork |
| **B** Develop a marketing plan for an IT product or service based on market research | **B1** Select a product or service idea to market for an IT enterprise<br><br>**B2** Research the market opportunities for an IT product or service<br><br>**B3** Marketing planning for an IT product or service | A marketing plan with supporting research identifying the approaches to be used when launching an IT product or service to the market. The market components of a Business Model Canvas or a Lean Canvas could be used, or alternatively a more traditional marketing plan template could be used. |
| **C** Present a plan for a start-up IT enterprise using lean or traditional business principles | **C1** Lean business planning<br><br>**C2** Traditional business planning<br><br>**C3** Create and present a start-up plan for an IT enterprise | Presentation of a plan for a start-up enterprise that suggests why the enterprise will become established and viable<br><br>The product components of a Business Model Canvas or a Lean Canvas could be used, or alternatively a more traditional business plan template could be used. |

## Assessment guidance

The assessment for this internally assessed unit would benefit from being divided into three assignments as shown above.

### Assignment 1 (learning aim A)

As the formal assessment for this learning aim, learners should create a video about a successful enterprise and the entrepreneur that explains the success of the enterprise. An example (for illustration purposes only – remember that the investigation should be IT related) would be Anita Roddick's Body Shop. What were the secrets of success?

Learners carry out a full personal skills audit and share it with their tutor. In this instance, they should also reflect on areas of weakness and what could be done to address these areas. The skills self-audit should identify both entrepreneurial and IT skills, abilities and consider teamwork.

Note that for distinction standard, learners will evaluate how the principles and characteristics of at least two IT enterprises have contributed towards their success.

### Assignment 2 (learning aim B)

Learners create a marketing plan for a product or service that they could develop (this should not be the product or service that was identified in the classroom groupwork). The plan should be supported by research and should identify approaches that would be used when launching an IT product or service to the market. Using a business model as outlined in the assignment brief, learners should demonstrate an understanding of the components that would be necessary to market the product or service.

### Assignment 3 (learning aim C)

A plan for a business start-up enterprise should be created and a presentation drawn from the content of the plan. It should suggest how and why the enterprise would become an established, viable business proposition. The choice of model for this assessment will be linked directly to the choice made in assignment 2. The learners must formally present their start-up plan.

# Getting started

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

## Unit 20: Enterprise in IT

### Introduction

This unit is a practical unit that makes use of learners developing business skills in addition to their technical learning. This is therefore a good unit for learners to study if they are considering working for themselves.

Even if they are not, because this unit teaches learners about self-marketing as well as product or service marketing, it will produce useful skills which also overlap into interview techniques.

### Learning aim A – Explore the nature of enterprise and entrepreneurship in an IT context

### Learning aim A1 – Entrepreneurship and enterprise principles and characteristics

**What is enterprise?**

- Learners look up a definition of the word enterprise and collaborate as a class to produce a definition of what enterprise could mean in relation to IT.

- A small group activity where learners create an A3 annotated poster that should explain what enterprise involves.

**What skills and capabilities are needed to support enterprise?**

- Lead a discussion on 'expertise' and why success in supporting an enterprise requires both entrepreneurial and technical skills. Discuss the skills and capabilities at top level and ask learners to offer suggestions about how they might bring missing skills to the enterprise if they do not have them. For example, family members with technical skills – but would they work for nothing?

- Explain why they should not attempt an enterprise where they do not have the expertise (even in part), if they do not have commitment, enthusiasm and motivation, or if they are particularly risk averse.

- Learners watch and discuss 'How to Motivate Yourself and Other People' (see link in resources section).

**What factors make enterprises successful?**

The factors that make enterprises successful are largely the same as for any project, such as skills and planning, but enterprise has an extra dimension, which is the marketing factor (both for the product or service and for the organisation – or the entrepreneur in general).

- Presentation focussing on success factors. At this stage, you are merely introducing the concepts and talking them through. Learners will have an opportunity to investigate factors such as competitive advantage, perception and market penetration later in the unit.

**What are the attributes needed by a successful entrepreneur?**

- Create a checklist in three columns. Column 1 should contain the attributes from the specification, column 2 should have the heading Definition, and column 3 should be labelled My Attributes. Ask learners to begin by working in pairs to write a short definition on the checklist for each of the attributes. They will know many

without needing to look them up, but some might prove a little more challenging.

- Learners individually reflect against each attribute to complete the final column before a class discussion. During the discussion, the learners should reflect whether the attribute is something that can be learned or whether it is something you either have or do not have.

- You could give learners the opportunity to work on any attributes they feel are weak using some of your centre's generic personal development resources.

**Enterprise planning and technologies and techniques for business**

- Learners work in small groups to investigate lean and traditional business modelling and planning techniques. Learners should be asked how they would 'teach' a group of adults running small businesses about the models and how they work. Learners should work in small groups and create a series of resources to support this kind of activity.

- Present on the new technologies used for enterprise such as cloud and open sourcing (see specification).

## Learning aim A2 – Skills audit and teamwork

**The skills of the entrepreneur**

- Use the 7 Key Entrepreneur Skills and Characteristics video listed in the resources section at the end of this delivery guide to lead a discussion on the wider range of skills needed to be successful in enterprise.

- Learners individually use the quiz listed in the resources to assess their own capabilities. Please ensure you read the note about Question 1. You should also ensure that learners print out the results.

- Learners individually use the second quiz listed to assess their own capabilities. You should again ensure that learners print out the results.

- Lead a class discussion where learners reflect on their performance in the quiz. Did both quizzes have the same or very similar results?

**Teamwork and collaboration**

- Presentation focussing on teamwork and collaborative working (including using online tools). Discuss the features of the Google Drive (including simultaneous editing of documents). What are the advantages and disadvantages of this functionality?

**Skills audit**

- Prepare documentation to enable learners to carry out a personal skills audit. The document should include technical skills, transferable skills, business skills, attributes and behaviours listed in the specification that are important in the context of this unit. You should include teamwork skills, leadership skills and any others that are relevant (you could also look at the skills required in the project unit if you need any extra detail).

- Learners carry out the skills audit and discuss the outcomes of the audit with you or their personal tutor. Where possible, learners should be directed to materials that they can use to address some of the weaknesses.

**Mentoring and networking**

- Individual activity or paired work to explore local mentoring and networking events. Learners should establish at least 5 business, entrepreneurial or enterprise networking or mentoring groups in their region.

## Learning aim B – Develop a marketing plan for an IT product or service based on market research

### Learning aim B1 – Select a product or service idea to market for an IT enterprise

**Identify an IT product or service idea**

- Lead a discussion that sets the scene for this learning aim. Many people assume that innovation comes only from developing new ideas, but the reality is that a significant number of innovations come from existing products or services approached in a new way. Sometimes this is a rebranding activity; it could be to enhance product or service, it could be finding a new market for an existing product or it could be a new way of doing something (which is why downloadable music and electronic books were innovations in their time). What is the up to date alternative to downloading music?

- Give a presentation to learners focusing on criteria that they should consider using to evaluate their ideas. This should include identification of product or service features, an assessment in relation to sustainability, security, usability, financial viability and potential market size (through identifying the target market). You should ensure that a legal assessment will also be undertaken in line with current legislation.

**Create IT product or service collateral to support market research**

- Learners work in small groups to come up with an idea for an IT product or service. It could be a new wearable technology, or an existing technology with new features. It could be a new media service or a new software application. Whatever they decide, learners should create a basic outline that can be used as part of research activity to test the potential for their idea. They should create design information (including storyboards and flowcharts) and possibly a prototype or a series of images (depending on the product or service they are choosing to research).

**Identify the skills required for marketing an IT product or service**

- Still working in groups, learners should discuss the skills that will be required for marketing the product or service including their combined product knowledge, knowledge of the market, how well they understand customer requirements and needs for their chosen market and the promotional methods they intend to use. The promotional methods chosen can be of a mixed variety and could include technology (such as social media), other media or more traditional methods. The choice made will, in part, be dictated by the target market. Decisions should be recorded in a development log or other suitable document for reference purposes.

### Learning aim B2 – Research the market opportunities for an IT product or service

**Qualitative and quantitative factors affecting a target market**

- Provide a brief for learners for small group research that instructs them to investigate the qualitative and quantitative factors affecting the market for a product or service.
  - What is a 'target market'? How do you identify one?
  - Having established the target market, what might the typical customer requirements and needs be for this group of individuals?
  - Are there gaps in the market that could be exploited?
  - What are the current market trends? Is there interest in this kind of product or service?

- What do competitors offer? Are there similar products or services?

- What is the economic climate like? Is the product or service luxury or essential? In times where the economy is struggling, consumers are less likely to invest in luxury products. What is the current situation?

- What are the business risks? Financial? Reputational?

It might be useful to provide the questions above as a gapped handout for learner to annotate during their research.

This should lead to a class discussion.

**Conduct market research on a prototype or design**

- Presentation that focuses on market research and the three key activities they will need to undertake.

  - Planning (including defining the purpose of the research and setting suitable objectives)

    - Deciding what data needs to be collected (primary, secondary)

    - How the data will be collected

  - Carrying out the research having:

    - Defined the sample size and method

    - Created the questionnaire or survey they will use

  - Learners carry out the research and then analyse the results

    - Analysing the results using statistical procedures

    - Presenting their findings

    - Drawing conclusions and making recommendations

    - Identifying any limitations.

- Continuing their group work, learners should plan and carry out the initial research as suggested. They should analyse and present the results, making recommendations about how to proceed. A presentation will help to formalise their thinking and will provide an opportunity for you to ask questions to clarify your understanding or point learners in the right direction if there is anything they have missed.

### Learning aim B3 – Marketing planning for an IT product or service

**Marketing plans**

- Having identified the nature of the product or service to be promoted, learners will create a marketing plan. You should begin by introducing learners to the components of a marketing plan. This would be best supported with a template that you have created that helps the learners to focus on the key components of a plan. There are a number available on the internet (see link in the Resources section of this guide) that you could adapt for this particular situation (ensure you cover the five points listed in the specification).

- Learners work in their groups to create the marketing plan for their idea.

**Market testing**

- Part of the plan is to test the market before committing resources to a project. A range of techniques have been listed. Learners should investigate the five options and decide which of the five would be relevant to their product or service, committing what they decide to their marketing plan.

| |
|---|
| **Deciding how effectiveness of the marketing plan will be measured** |
| ● To complete the plan, learners need to decide how they will measure the effectiveness of the marketing activity. Learners explore the following and then decide which metrics they will use in this activity: <br>     o  Volume of sales and rate of sales growth <br>     o  Size and growth of market share <br>     o  Customer perceptions of the product <br>     o  Sales revenue in relation to marketing costs. |
| **Learning aim C – Present a plan for a start-up IT enterprise using lean or traditional business principles** |
| **Learning aim C1 – Lean business planning** |
| **Learning aim C2 – Traditional business planning** |
| ● Introduce learners to the concepts of lean business planning and traditional business planning at a top level only. You could use the 2 minute Business Plan versus Business Model Canvas video (listed in the resources section of this delivery guide). <br><br> ● Give a presentation focusing on lean business planning and traditional business planning (as outlined in the specification) with more detail than in the video. You should create templates in advance, one for each business planning model outlined. There are two additional videos listed (totalling 31 minutes) that will provide useful content for the presentation. <br><br> ● Invite a guest speaker, if possible, (ideally an IT entrepreneur) to talk to learners about the business planning techniques they use. Are they traditional, or do they opt for the lean approach. |
| **Learning aim C3 – Create and present a start-up plan for an IT enterprise** |
| ● Learners work in their groups and use the outcomes of the previous group work (outline idea, market research plans, factors affecting decisions, outline design/prototype, results of market research, marketing plan and testing strategy and metrics for measurement and the outline business plan) to create a start-up plan for their IT enterprise. This should be an outline plan (a full business plan would be beyond the scope of this activity). The choice of model (lean or traditional) is at the discretion of the group. <br><br> ● Learners should create a presentation that they will formally present to an audience. The audience can be made up of local employers, businessmen or women, other tutors etc. Learners should seek feedback from the audience. <br><br> ● Each group should write a short report that reflects on the feedback they received, and should review their business plan accordingly, stating in the report the nature of the changes they made and the reasons why. |

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

Depending on the choice of project, the following units will provide useful underpinning knowledge and skills that can be drawn on to create the deliverables:

- Unit 3: Using Social Media in Business

- Unit 14: IT Service Delivery

- Unit 21: Business Process Modelling Tools

# Resources

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

### Textbooks

Mariotti S, *The Young Entrepreneur's Guide to Starting and Running a Business: Find Out Where The Money Is... And How To Get It* (Updated edition), Crown Business, 2014 ISBN 9780385348546 – examples of how young entrepreneurs started their own businesses by turning a range of hobbies, skills and talents into profitable enterprises

Ries E, *The Lean Startup: How Constant Innovation Creates Radically Successful Businesses* (1st Edition), Portfolio Penguin, 2011 Kindle version only – full of practical principles this book has had excellent reviews.

### Videos

7 Key Entrepreneur Skills and Characteristics (6.5 minutes) – this video outlines the key skills needed to be successful including many of those listed in the specification (https://www.youtube.com/watch?v=NtOfO5f4-Do).

Business Plan vs Business Model Canvas (2 minutes) – a short video that compares the traditional with the lean approach (https://www.youtube.com/watch?v=zibpovqIx2g).

How to write an effective business plan (15 minutes) – the more traditional approach to producing a business plan (https://www.youtube.com/watch?v=zfxWlOAVvbU).

The Lean Canvas Business Model – Creating The Killer Business Plan (16 minutes) – this video is a good introduction to this business process model (https://www.youtube.com/watch?v=uE34HsmT6E0).

### Websites

http://www.business-network.co.uk/ – The Business Network – lunches, seminars and meetings to explore the local business environment

https://www.entrepreneur.com/article/247560 – Quiz: What's your entrepreneurial IQ? – this is a fun, 22-question quiz that assesses your entrepreneurial capabilities. Question 1 shows that the quiz is targeted at US candidates, but learners should treat this as UK and the quiz does still work well. At the end you see your results and how you compare to others who have taken the test.

https://www.entrepreneur.com/article/246454 – Quiz: Do You Have What It Takes To Be An Entrepreneur? – a second quiz made up of 21 questions. In this variation, learners are given the results for each question as they move through the quiz (in other words, why their answer is correct or not in relation to becoming an entrepreneur). There is also a final result.

http://www.findnetworkingevents.com/ – Find Networking Events – a UK directory that can be filtered by region and town. Sample events could include Women's Business Clubs, but would be relevant for your area.

http://www.marketingdonut.co.uk/marketing/marketing-strategy/your-marketing-plan/marketing-plan-template – Marketing plan template – this template is really straightforward and easy to understand and is a useful tool.

http://www.technewsworld.com/ – TechNewsWorld – an online magazine with articles about cutting edge and emerging technologies across computing, the internet, mobile technology and security (among other areas)

http://yena.co.uk/ – YENA – a UK-based business networking opportunity for the young and ambitious. They advertise that they are seeking young entrepreneurial talent.

*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.*
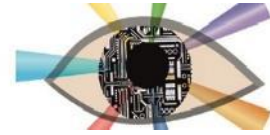
# Unit 21: Business Process Modelling Tools

## Delivery guidance

### Approaching the unit

This unit is an opportunity to acquire knowledge and skills in business process modelling which is part of the business process reengineering (BPR) methodology.

To understand this as a concept, learners first need to understand how businesses and their processes are structured.

**The approach to this unit should be:**

- The use of case studies is essential to bring this unit to life and while some links have been provided you should make use of other case studies or relevant news items at your discretion.

- Business scenarios should provide a context for all activity and assessment.

### Delivering the learning aims

#### Learning aim A

Consider mission statements and organisational aims and objectives. You could begin by discussion your centre's mission statement with learners. What does it mean? What does it mean to them? What are the objectives of a centre of education?

Learners will have an opportunity to consider a number of real organisations and while some are named, these can be replaced with organisations of your choice, or theirs if you prefer.

What is customer satisfaction? How important is service, price and quality on how business processes are structured and work?

Investigating organisations and business structures, sectors and functional areas will allow learners to comment on the internal workings of formal entities. As it is unlikely that they will all have an intimate knowledge of a business as employees, you could use the centre as one of the organisations investigated. Which functional areas does your centre have? Is there an R&D or a Manufacturing function? In the case of a school or college, what replaces manufacturing?

Learners will be introduced to business processes by category (management, operational and supporting) and will consider how these interlink to enable the business to operate.

Changing business processes has inherent risks and some of these are explored, along with ways of mitigating the impact of the risk or risks on the ongoing operations of the business or organisation.

#### Learning aim B

The investigation methods used to understand business processes are the same as those that would be used in any project situation and learners will meet these concepts again when undertaking *Unit 9: IT Project Management*.

Formal recording of the investigation should take place using different methods as appropriate for the situation. This will enable analysis to take place, with problems

decomposed to a lower level to aid understanding. Alongside the attributes of the process or processes, the rules which are used in the process will also be defined.

Learners will use business process modelling tools, investigating them as part of the classroom activity and applying them in the assessment.

**Learning aim C**

In the final learning aim, learners consider where innovation comes from. You will explain to learners that innovation can take many forms (such as improving a service, improving the communication between departments, finding better ways of organising production).

Formally investigating Business Process Reengineering will bring this unit to a close and learners will consider the impact of this activity by studying the effects of change on an organisation and its stakeholders. Risk and risk mitigation is essential in managing the process change activity.

Throughout the unit, learners will be expected to demonstrate the skills, knowledge and behaviours that will prepare them to be professional practitioners on completion of this qualification.

## Assessment model (in internally assessed units)

| Learning aim | Key content areas | Recommended assessment approach |
|---|---|---|
| **A** Investigate the processes that organisations use to support their activities | **A1** Business aims and objectives<br><br>**A2** Organisational models and department functions<br><br>**A3** Types of business processes<br><br>**A4** Drivers for change | A report, blog or presentation materials covering business aims and objectives, organisational models, department functions and reasons for change |
| **B** Examine an organisation's business processes and activities to inform improvements | **B1** Investigation methods<br><br>**B2** Analysis of a business process<br><br>**B3** Business process modelling tools | Interview recordings, observation statements and documentation providing evidence of the investigations<br><br>Annotated diagrams of business processes |
| **C** Develop a plan to improve an organisation's business processes and activities | **C1** Sources of innovation to improve business processes<br><br>**C2** Business process redesign and improvement<br><br>**C3** Change management<br><br>**C4** Skills, knowledge and behaviours | Records of discussions covering the analysis of the impact of business process changes<br><br>Annotated diagram of the improved business processes<br><br>Evidence of feedback (recording of discussions or written feedback)<br><br>Recorded or written evaluations of the plan and the working practices |

## Assessment guidance

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

### Assignment 1 (learning aim A)

As the formal assessment for this learning aim, learners should create a blog, report or presentation materials covering business aims and objectives, organisational models, department functions and reasons for change.

Learners should explain how different types of business processes are used to support the needs of an organisation and how technologies can be used as part of this.

**Assignment 2 (learning aims B and C)**

This assignment combines learning aims B and C into an investigative project. Learners will produce interview recordings, observation statements and documentation providing evidence of the investigations.

Annotated diagrams of business processes. Records of discussions covering the analysis of the impact of business process changes (identifying both the positive and negative effects).

An annotated diagram of the improved business processes should be created as it can be used to compare the previous state of the process with its new state.

Evidence of feedback (recording of discussions or written feedback) is essential and recorded or written evaluations of the plan and the working practices complete the assessment requirements.

# Getting started

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

| Unit 21: Business Process Modelling Tools |
| --- |
| **Introduction** |
| In order to understand the benefits to business of using IT and technology in their activities, learners must understand basic business concepts. This unit provides an opportunity for learners to develop their knowledge and enables them to make the link between business and technology, exploring how these work together. |
| **Learning aim A – Investigate the processes that organisations use to support their activities** |
| **Learning aim A1 – Business aims and objectives** |
| **Organisational aims and objectives, mission statements and business goals**<br><br>● You are going to introduce learners to the concept of business aims and objectives, and the nature and role of business mission statements and goals. Use the 8-minute video listed in the resources as a focal point to stimulate a class discussion. This should be followed by a Q&A to check understanding.<br><br>**Importance of service levels, customer satisfaction, quality and pricing**<br><br>● Small group activity to investigate why service, customer satisfaction, quality and pricing are important aspects. Learners should search the internet to find news items about how businesses approach these concepts. The following ideas may help:<br><br>   o Which? has carried out a poll of the best and worst businesses for customer service<br><br>   o Amazon and John Lewis are ranked as two of the best in the UK for customer satisfaction. Why? What other notable companies are on the list? Learners should consider their personal experience of these organisations and whether they would agree with their position in the ranking as listed in an October 2016 Guardian news article.<br><br>   o Which companies have a good reputation for quality? Forbes research suggests that The Walt Disney Company was ranked as number 1 in 2014. Learners should consider some of the other 99 on the list – is this ranking for Disney deserved? The Forbes ranking is global and includes only 5 UK companies in the top 100. What do learners think?<br><br>   o Why is pricing important? Price Waterhouse Cooper has carried out an analysis and made recommendations. What do they say about the role of price in business success?<br><br>Learners should carry out research and create and present a slide presentation to the class. You could consider allocating a single component to each group such as price or customer satisfaction. This will give learners more time to focus on a single area and find more examples that they can use to illustrate their findings. This will also mean a wider range of presentation for learners to watch. |
| **Learning aim A2 – Organisational models and department functions** |
| **Types of organisation or business** |

- Produce a table with three columns, one for Organisation Type, one for Description and one for Examples. Populate the first column with the categories listed in the specification. Distribute this to learners and then lead a discussion that will enable them to complete the table. They should be able to give examples of businesses in each category, although for sole trader they may have to rely on the type of job (e.g. plumber or electrician) rather than the name of an actual business.

**Industry sectors**

- Learners work in pairs to define industry sectors – what do the following mean?

  Primary, Secondary, Tertiary

  Learners should write a definition and identify real-world examples of companies in each category. They should share their definitions and examples with the class.

**Department functional areas**

- Download an image for Business Functional Areas that most closely resembles the list (an image link is included in the resources section). Print onto A4 and distribute to learners. Learners take part in a class discussion and annotate the diagram with a description of the basic functions of each of these areas.

**How functional areas interlink to support business aims and objectives**

- Prepare a presentation that considers how different areas interlink. This should be a top level presentation only that prepares learners for the next topic.

### Learning aim A3 – Types of business processes

**Management, Operational and Supporting processes**

- Small group work that explores the three key business processes. Learners use the 38-slide presentation and notes (see link in resources) to create teaching resources that they will use to teach the rest of the class. You could split the content (per the title) into three and allocate a specific area to each group. This will mean that they will have to extract relevant content from the presentation, and support it with additional research.

### Learning aim A4 – Drivers for change

**Reasons why business processes need to change**

- Although this part of the specification only lists the reasons why business processes need to change, you should present a balanced view by discussing not only the benefits, but also potential resistance and challenges that business managers could face in trying to implement organisational and process change. This is covered in more depth in learning aim C3 towards the end of the unit. Create and deliver a presentation to cover the content described.

- Learners should create either a crossword puzzle or dominos game using their research (see links in resource). The other options (such as wordsearch maker), are not relevant for this level. The completed game should be tried/used by other learners in the class.

### Learning aim B – Examine an organisation's business processes and activities to inform improvements

### Learning aim B1 – Investigation methods

**Methods used to understand business processes**

- Learners work in pairs to research methods used to understand business processes. They should collaborate to create a short podcast that can be uploaded to the centre

or course intranet or class social media page so that it can be shared and viewed by others. Learners should not be restricted to the three methods listed in the specification and you could encourage them to carry out additional research and add additional methods. For example – could a questionnaire be used as a method for gaining information about business processes? The completed podcasts should be viewed and critiqued by the class.

**Methods of recording the details of processes**

- Observing processes as they happen can be a useful tool in understanding business processes. For this activity, learners should work in threes. Each team will investigate the same process (just one from the list below, or an alternative you decide to include).

  o Organise four business/organisational activities for learners to observe for 5 minutes. This could be:

    - Your centre's receptionist processing a visitor
    - An IT technician responding to and repairing a fault or carrying out an upgrade
    - A member of your centre's web development team making changes to the centre's website
    - A member of the accounting team processing incoming invoices.

During the observation learners are not allowed to interact with the process. A video recording and audio recording of the process should be made, and the third learner should take notes.

Following this activity, learners should compare the three records and answer a series of questions.

1) Which process was the best for capturing the most detail?

2) What are the advantages of each method?

3) Identify the disadvantages of each method.

4) Might any of the other methods studied have provided additional information? Which methods and how?

Learners should write down the inputs, processes and outputs of the activity they observed.

## Learning aim B2 – Analysis of a business process

**The purpose and nature of the business process including inputs, outputs and process attributes**

- Deliver a presentation that focuses on business processes and the different forms they take – for example, paper-based records for recording accounting activity, physical activities such as adding items or removing them from stock, IT-based manufacturing systems such as CAD/CAM.

- Lead a class discussion asking learners about inputs, processes and outputs, linking this back to programming units that they have already studied. Discuss process attributes (these are all the components required for the process – for example, the attributes of a calculation are the data items used and the arithmetic operators).

**Decomposition**

- Define decomposition and the concept of the sub-process and explain how rules apply (decision points).

● Learners investigate decomposition in pairs using the link provided in the resources section in this document. The guide provides hints and tips on how to undertake this activity. Learners should create a checklist or some other aide memoir.

**Individual activities of processes, rules and decision making**

● Provide at least four different business processes for learners to decompose. Learners should work in pairs to break down the process into its inputs, processes and outputs, identifying the attributes of the process and any rules that apply.

### Learning aim B3 – Business process modelling tools

**Tools used to model business processes**

● Guest speaker should be invited to explain how they use business modelling tools in their job role. They should provide examples of these documents for learners to view and ask questions about.

● Develop this topic further by asking learners to work in pairs and choose two of the four modelling tools to investigate. Each pair should create a guide to the modelling tools they have chosen. The completed guides should be presented (talked through, not a formal presentation) to the class and should be shared by all members of the class.

### Learning aim C – Develop a plan to improve an organisation's business processes and activities

### Learning aim C1 – Sources of innovation to improve business processes

**Sources of innovation to support process improvement**

● Begin with a class discussion. What is innovation? Allow learners to provide examples. The examples they provide may well be limited to new technologies (such as wearable devices) or new services (such as video streaming) that they have come into contact with. Explain to learners that innovation can take many forms (such as improving a service, improving the communication between departments, finding better ways of organising production).

● Deliver a presentation on sources of innovation. Where does innovation come from? The specification suggests four potential sources, but this list is not restrictive and you can add some of your own.

**Problem solving and idea creation methods**

● Lead a class discussion about brainstorming. Discuss the pros (can take ideas in new and unexpected directions) and cons (can be a poor use of time, can end up with too much information to manage, can lack control) of this method for problem solving and idea creation.

● Work in small groups to investigate cause and effect diagrams (also known as Fishbone or Ishikawa diagrams). They are used in many analytical methodologies – for example, Root Cause Analysis. What is a cause and effect diagram? What is it used for? A link to a video has been provided in the resources list.

● Learners interpret a fishbone diagram (links to two IT-specific examples have been provided), before creating a diagram based on a case study you will provide. The final two minutes set out an exercise which you could use and adapt as a problem for your learners to solve.

### Learning aim C2 – Business process redesign and improvement

**Business process reengineering (BPR)**

● Introduce the concept of BPR (as a component of continuous business improvement) through a discussion about the reasons why business processes need to be analysed, redesigned, implemented and tested (e.g. to realign business processes to altered objectives, to make use of new technologies, meet new demands from stakeholders such as changes in legislation or environmental considerations). This can be achieved through a presentation or discussion.

● Learners watch the BPR Case Studies video (see links), taking notes. You will need to pre-watch the video and set up some questions that you will be able to use in the subsequent class discussion.

**Use of technologies which can support process change**

● Class discussion, brainstorming available technologies that can contribute to the process of change. While some are listed in the specification there are many more that could be suggested. Learners should create a single A3 or A2 poster as a class that can be placed on the classroom wall as an aide memoir. The poster should identify a range of technologies, giving ideas on how each one could potentially be used.

**Learning aim C3 – Change management**

**The effects of change on an organisation**

● Pose a question to start a class discussion:

In 2002, Dyson moves manufacturing operations from the UK to Malaysia.

Learners investigate to answer:

o What were the benefits for Dyson?

o What was the impact of this on staffing?

o What was the impact on resources?

o How were customers affected?

o What were the effects on the local economy (in the UK and in Malaysia)?

Learner research should go beyond the single link provided in the resources section.

Once the investigation has been completed, you should lead a discussion on the actions of Dyson.

**Process change risks and risk mitigation**

● You will provide a scenario/case study that allows learners to work in pairs or small groups to prepare briefing documents or a presentation that will initially reassure staff about impending business process change. This presentation should itself be presented to senior managers of the business, as part of a leadership team briefing, which should also include coverage of the risks that will be present during process change, and suggesting how some of these risks could be mitigated. The senior managers should be left in no doubt about the nature and extent of the potential risks and learners should show that they have considered mitigating as many as possible, also highlighting those where there is the greatest challenge.

**Learning aim C4 – Skills, knowledge and behaviours**

For this unit learners will demonstrate an understanding of the skills knowledge and behaviours that would need to be displayed as part of a business process remodelling activity.

Some or all of these skills have been covered in early units in this course (such as Units 3, 4, 5 and 6 – among others). For this reason, no new content will be added here. Learners should apply the skills learned in other units in this context. They will need to demonstrate continued professionalism, planning and recording skills and evaluating outcomes in the same way as in other units.

Particularly important, in the context of this unit, is the process of evaluation and ensuring that learners can fully justify their recommendations, decisions and approach taken to the tasks.

They should ensure that they demonstrate appropriate communication skills and are able to convey their meaning clearly, using an appropriate tone and language, and respond constrictively to contributions of others.

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

Depending on the choice of project, the following units will provide useful underpinning knowledge and skills that can be drawn on to create the deliverables:

- Unit 2: Creating Systems to Manage Information

- Unit 5: Data Modelling

- Unit 14: IT Service Delivery

- Unit 15: Customising and Integrating Applications

- Unit 20: Enterprise in IT

# Resources

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

### Textbooks

Ahmed T, Cox J, Girvan L, Paul A, Paul D, Thompson P and Cadle J, *Developing Information Systems: Practical Guidance for IT Professionals* (1st Edition), BCS (British Computer Society), 2014 ISBN 9781780172453 – information systems that support business are made up of hardware, software, data, procedures and people. This book is an introduction to this subject and sector of the IT world.

Cadle J, Paul D and Turner P, *Business Analysis Techniques: 99 Essential Tools for Success* (2nd Edition), BCS (British Computer Society), 2014 ISBN 9781780172736 – a guide for business analysts produced by the British Computer Society. This guide considers a range of techniques and how to apply them.

Holt J, *A Pragmatic Guide to Business Process Modelling* (2nd Edition), BCS (British Computer Society), 2009 ISBN 9781906124120 – a practical guide to business process modelling that considers how effective and accurate modelling helps businesses understand their current position so that they can respond to future requirements.

### Videos

BPR Case Studies (24 minutes) – a short lecture on BPR and how it has been applied in the context of a number of businesses to change the way that they operate (https://www.youtube.com/watch?v=bca91f2zIJE).

Cause and effect analysis (2 minutes) – an introduction to cause and effect diagrams. It covers how to create a diagram and how to use it (https://www.mindtools.com/pages/article/newTMC_03.htm).

Decision Tables (4.5 minutes) – a short video that explains the use and context of decision tables (https://www.youtube.com/watch?v=oK1ZLM0irWM).

How to draw a UML Use Case Diagram (6 minutes) – a short video that explains Use Case Diagrams - what they are and what they mean (https://www.youtube.com/watch?v=UzprPX82Nac).

Organisational Objectives in Business Activity (8 minutes) – an overview of the cornerstones of business explaining how and why businesses formalise these components (https://www.youtube.com/watch?v=vT-50mH2Lmg).

Problem Solving Techniques #8: Flow charts (7 minutes) – how to draw and use flow diagrams (https://www.youtube.com/watch?v=hN9xemJYwos).

Process Mapping (33 minutes) – this is a comprehensive video which may be better set as homework (https://www.youtube.com/watch?v=LJwKZuQUb7g).

UML 2.0 Activity Diagrams (12.5 minutes) – how to create and use Activity Diagrams (https://www.youtube.com/watch?v=XFTAIj2N2Lc).

Why risk management? – if the objectives of business process improvement is to ensure that organisations run smoothly and profitably, how should risks be managed? This article makes some suggestions (http://www.sword-activerisk.com/why-risk-management/enterprise-risk-management/opportunity-management/business-process-improvement/).

**Websites**

http://www.forbes.com/sites/susanadams/2014/04/08/the-worlds-most-reputable-companies/#6468a3c758c6 – The World's Most Reputable Companies – the results of a survey naming the top 100 companies in the world for a good reputation.

http://it.toolbox.com/blogs/enterprise-solutions/guidelines-for-decomposing-business-functions-and-processes-14635 – Guidelines for Decomposing Business Functions and Processes

http://news.bbc.co.uk/1/hi/business/1801909.stm – Dyson to move to Far East – a BBC News article about the move of Dyson manufacturing activities to Malaysia

http://www.pwc.co.uk/services/consulting/pricing/the-power-of-pricing-nows-the-time-to-take-it-seriously.html – The Power of pricing: How to make an impact on the bottom line – an article that explores price as an important contributory factor in business success

http://slideplayer.com/slide/4949823/ – Chapter 7 – Transaction Processing, Functional Applications, CRM and Integration – a comprehensive presentation covering Management, Operational and Supporting processes in business

http://www.telegraph.co.uk/finance/newsbysector/retailandconsumer/12109854/The-companies-with-the-best-customer-service-in-the-UK.html – The companies with the best customer service in the UK – a Telegraph news article published on 31st October 2016

http://www.toolsforeducators.com/dominoes/ – Domino maker – this is a free online game maker for paper/card-based dominoes. Learners supply the content (term and definition) and complete a series of dominoes that can be printed and played as an educational game.

https://uk.pinterest.com/pin/445786063095086708/ – Business functional areas – this image covers the list of functional areas listed in the specification, with the addition of IT and Support.

http://www.which.co.uk/news/2015/09/uks-worst-firm-for-customer-service-revealed-by-which-poll-414947/ – UK's worst firm for customer service revealed by Which? poll – the best and worst brands for customer service identified by a 2015 survey.

**Fishbone diagrams for interpretation:**

http://webandnewmedia.tumblr.com/page/5

http://whatis.techtarget.com/definition/fishbone-diagram

*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.*