Higher National Unit Specification

General information

Unit title: Blockchain (SCQF level 7)

Unit code: J1GV 34

Superclass: CC

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Version: 01

Unit purpose

The purpose of this unit is to **introduce** learners to the concepts underpinning Blockchain, and explore how this technology is used in a range of employment sectors, particularly fintech. This is a **non-specialist** unit intended for a wide range of learners, particularly those with a vocational interest in computing, financial services or supply chain management. However, any learner may benefit from developing an understanding of how this emerging technology is affecting business and society.

Learners will gain an understanding of the **basic** principles of Blockchain, and discover how the technology is used to create applications and services for a range of market sectors. The focus of the unit is on the core constructs that comprise Blockchain such as cryptography, distributed ledgers, block verification, smart contracts and cryptocurrency. Application development is not covered.

On completion of this unit, learners may progress to *Blockchain* at SCQF level 8, which explores the coding principles of Blockchain and how they are applied to create and enforce smart contracts and build distributed applications.

Outcomes

On successful completion of the unit, the learner will be able to:

1 Describe the development of Blockchain.
2 Explain the operating principles of Blockchain.
3 Describe the applications of Blockchain.

Higher National Unit Specification: General information (cont)

Unit title: Blockchain (SCQF level 7)

Credit points and level

1 Higher National Unit credit at SCQF level 7: (8 SCQF credit points at SCQF level 7)

Recommended entry to the unit

No previous knowledge or experience of Blockchain is required. It would be beneficial if learners possessed some knowledge of cryptography and coding. This may be evidenced by possession of HN units such as J0HA 34 *Computer Programming*, J0H9 34 *Data Security* or J0HK 34 *Ethical Hacking*.

Core Skills

Opportunities to develop aspects of Core Skills are highlighted in the support notes for this unit specification.

There is no automatic certification of Core Skills or Core Skill components in this unit.

Context for delivery

If this unit is delivered as part of a group award, it is recommended that it should be taught and assessed within the subject area of the group award to which it contributes.

Equality and inclusion

This unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website **www.sqa.org.uk/assessmentarrangements.**

Higher National Unit Specification: Statement of standards

Unit title: Blockchain (SCQF level 7)

Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

Where evidence for outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Learners should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Describe the development of Blockchain.

Knowledge and/or skills

- Definition and derivation of Blockchain
- Historical development of Blockchain including distributed networks
- Milestones in the development of Blockchain including Bitcoin
- Blockchain concepts and components including Blockchain nodes, cryptographic techniques and certificate authority
- Limitations of traditional transaction systems including types of market friction

Outcome 2

Explain the operating principles of Blockchain.

Knowledge and/or skills

- Centralised and decentralised ledgers
- Permissioned and permissionless ledgers
- Characteristics of a Blockchain network
- Blockchain standards including what constitutes a block
- Importance of cryptography as a security provider for Blockchain
- Roles in a Blockchain system including regulator and certificate authority
- Types of security provided by Blockchain including block verification processes
- Peer nodes and the Blockchain governance model

Higher National Unit Specification: Statement of standards (cont)

Unit title: Blockchain (SCQF level 7)

Outcome 3

Describe the applications of Blockchain.

Knowledge and/or skills

- Applications of Blockchain including financial services, cross-border finance, government, supply chain management, healthcare and the internet of things
- Role of smart contracts in the operationalising of business processes in the Blockchain
- Cryptocurrencies including Bitcoin and ScotCoin
- Use of the Blockchain through decentralised applications (dApps) to expedite app development
- Benefits and challenges of Blockchain compared to traditional database technology
- Key considerations for implementing Blockchain
- Ethical aspects of Blockchain including improved transparency in the supply chain

Evidence requirements for this unit

Learners will need to provide evidence to demonstrate the knowledge and/or skills across all outcomes. The evidence requirements for this unit will take **one** form.

1 Knowledge evidence

The **knowledge evidence** will relate to Outcomes 1–3. Knowledge evidence is required for all knowledge and/or skills statements. The amount of evidence may be the minimum required to infer competence. The evidence may be produced over an extended period of time in lightly controlled conditions.

Knowledge evidence may be sampled when testing is used. In this case, the evidence must be produced under controlled conditions in terms of location (supervised), timing (limited) and access to reference materials (not permitted). The sampling frame must cover all outcomes (1–3) but not all knowledge/skills statements; however, the majority of the knowledge/skills should be sampled (at least once) in every instance. The sampling frame must include questions relating to the following knowledge and/or skills statements:

- Definition and derivation of Blockchain
- Characteristics of a Blockchain network
- Applications of Blockchain (in at least two areas)

The evidence may be written or oral or a combination of these. Evidence may be captured, stored and presented in a range of media (including audio and video) and formats (analogue and digital). Particular consideration should be given to digital formats and the use of multimedia.

The SCQF level of this unit (Level 7) provides additional context on the nature of the required evidence and the associated standards. Appropriate level descriptors should be used when making judgements about the evidence.

When evidence is produced in loosely controlled conditions, it must be authenticated. The guide to assessment provides further advice on methods of authentication.

The support notes section of this specification provides specific examples of instruments of assessment that will generate the required evidence.

Higher National Unit Support Notes

Unit title: Blockchain (SCQF level 7)

Unit support notes are offered as guidance and are not mandatory.

While the exact time allocated to this unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this unit

The purpose of this unit is to provide learners with the knowledge required to understand, communicate and apply the basic concepts of Blockchain, and establish the foundation required to pursue more technical skills and knowledge in Blockchain and other related areas, such as financial services, computer programming, IT, and cyber security. In terms of workforce readiness, this unit will equip learners with a valuable narrative and subject matter expertise on this rapidly evolving and disruptive emerging technology that is in historic demand in the marketplace.

The following paragraphs provide additional guidance for each individual outcome in this unit.

Outcome 1

The primary objective related to this outcome is to provide learners the key facts and details related to the historical evolution of Blockchain technology and provide an understanding of the most basic components of Blockchain via exposition, disambiguation (eg, the difference between Blockchain and Bitcoin), and knowledge transfer on the key business impacts of this disruptive technology. For most learners, this should be considered and presented as their first introduction to Blockchain.

Outcome 2

The primary objective relating to this outcome is to provide learners with a concrete mental model of the core principles and related processes that comprise Blockchain solutions. It is extremely important that they demonstrate understanding of the system-based flow of Blockchain transactions (eg, how data flows from user input through to governance models, peer nodes, and ultimately to a new block that is added to all peer nodes' ledgers) as a prerequisite to understand how Blockchain is applied in Outcome 3 of this unit.

Outcome 3

The primary objective relating to this outcome is to provide learners with a broad understanding of how Blockchain is currently being used and how it is likely to be used in the near to long-term future. This knowledge should prepare learners to transfer these applications to other markets and solution types and prepare them for being contributors or leaders in how Blockchain could be applied in their place of employment.

Higher National Unit Support Notes (cont)

Unit title: Blockchain (SCQF level 7)

With the explosion of fintech and cryptocurrency market in general, the demand for tech-savvy professionals has grown significantly. For example, online freelancing site, Upwork, saw the growth rate for Blockchain jobs on the site surpass 2,000% for three quarters (2018) and posted a 6,000% year-over-year growth rate for that year. Furthermore, Burning Glass Technologies reports there were 5,743 mostly full-time jobs in the Blockchain sector posted in 2018, which represents an annual growth rate of approximately 320%.

Introducing challenge into this astronomic increase in demand, there are scarce options for practitioners to be introduced to, or upskill in Blockchain knowledge and skills as the training and education sector have traditionally been quite sluggish in updating their offerings to match current market requirements, particularly in emerging technology. The rapidity in the emergence of Blockchain has made the lack of related offerings even more glaring.

These facts underpin the importance of the knowledge and skills covered within this unit in terms of providing pathways to reliable employment opportunities.

Mastering the Blockchain outcomes provided in this unit is a valuable set of skills for any learner pursuing a career in an environment where Blockchain is currently being used, or in the organisational roadmap.

Potential Blockchain-specific career roles for individuals possessing this unit would be IT professional, including app/dApp (decentralised application) developers and cyber security specialists; financial services/fintech professional in areas such as investor advisory, cryptocurrency services, and ICO support; and pre-sales and sales professionals for Blockchain-related products and solutions.

Existing/traditional market sectors that are experiencing a significant surge in demand for Blockchain professionals include: financial services (fintech), legal services, insurance and supply chain management, among several other common types of commercial and governmental organisations.

The concepts related to Blockchain technology present a rich sandbox for developing and applying the skills essential to computational thinking. The diversity of process types and systems that work together to support the Blockchain can be complex, so it is important to reinforce computational thinking techniques as learners progress through this unit to prime them for application and transfer of this knowledge in a meaningful and practical manner.

Specific examples of opportunities to develop computational thinking in this unit:

- **Abstraction —** understanding Blockchain processes requires learners to think abstractly and to operate simultaneously on multiple layers of abstraction to master the principles and corresponding processes related to Blockchain.
- **Decomposition —** given that Blockchain transactions and solutions have many discrete components that work together in a system-based manner, learners will be required to think and communicate about Blockchain in a decomposed collection of largely independent and specialised technologies and processes.

Higher National Unit Support Notes (cont)

Unit title: Blockchain (SCQF level 7)

Guidance to specific outcome statements

Please note that the following guidance, relating to specific outcomes, does not seek to explain each knowledge/skills statement, which is left to the professionalism of the educator. It seeks to clarify the statement of standards where it is potentially ambiguous. It also focuses on non-apparent teaching and learning issues that may be over-looked, or not emphasised, during unit delivery. As such, it is not representative of the relative importance of each knowledge/skill.

Outcome 1: Describe the development of Blockchain.

The overarching learning goals for learners in Outcome 1 is to provide them with the foundational knowledge of Blockchain that is requisite for understanding how the Blockchain systematically operates which is addressed in Outcome 2. This is the primary reason that it is strongly recommended to cover the knowledge/skills in Outcome 1 before progressing to the material in Outcome 2. Learners should be comfortable describing what Blockchain is, where it came from, and its core concepts and components in preparation for seeing how they behave in a system of processes in Outcome 2.

A useful reference for both, educators and learners, for this outcome is *Blockchain for Dummies* created by IBM and available online from several trusted sources on the Internet. This reference is free to download.

Another helpful reference is Matthew Connor's book *Blockchain: Ultimate Beginner's Guide to Blockchain Technology*, available from Google Books and in Audiobook format from Audible, among several other locations on the internet.

There are many other free or inexpensive references available online with the most reliable sources being Investopedia (**https://www.investopedia.com/**) and the Bitcoin Wiki (**https://en.bitcoin.it/wiki/Main_Pagehttps://en.bitcoin.it/wiki/Main_Page**).

Wikipedia also maintains frequently updated pages on most of the standalone topics covered in this unit. However, it is important to note that these sites are informational sites and not educational sites and, as such, are intended to be used as a reference for keeping up with evolving technologies and standards related to Blockchain.

With regard to some of the specific knowledge to be covered in this unit, the information below may be useful to educators:

- Definition of Blockchain.
  - Many concise definitions that touch all the main topics of this unit are easily located online. The standard definition may change periodically so it is considered a good practice to research recent definitions prior to each term in which this unit is delivered.
  - A good standard definition of Blockchain from medium.com:
    - 'A Blockchain is a cryptography-based, tamper-resistant distributed ledger that stores data in a consensus driven, peer-to-peer network.'

Higher National Unit Support Notes (cont)

Unit title: Blockchain (SCQF level 7)

- Historical development of Blockchain, including distributed networks.
  - It is important to note that the core technology of Blockchain started in 1991 as a system whose documents' timestamps could not be altered in any way (Haber, Stuart; Stornetta, W. Scott (January 1991). 'How to time-stamp a digital document'. *Journal of Cryptology*. 3 (2): 99–111. doi:10.1007/bf00196791.) This approach did not gain adoption until Satoshi Nakamoto decided to utilize it to build the first Blockchain in 2008 as the core component and distributed ledger technology for his ground-breaking cryptocurrency, Bitcoin.
  - Differentiation between Bitcoin and Blockchain.
    - There is an extremely common misconception that Bitcoin and Blockchain are the same thing. This presents a significant barrier to learning about Blockchain. The key point to make in this distinction is that Blockchain is a technology and that Bitcoin was the first application built on this technology. This application was designed by Satoshi Nakamoto in 2008 for a very specialised application of Blockchain, creating a cryptocurrency called Bitcoin. Bitcoin is one of several cryptocurrencies on the market, with new cryptocurrencies being created nearly every day via ICOs (Initial Coin Offerings) and through the release of other Blockchain platforms that require mining services. Cryptocurrency is only one application of Blockchain technologies.
- Limitations of traditional transaction systems, including types of market friction.
  - The two key areas to address on this statement are:
    - How Blockchain addresses the **Double Spending Problem** via irreversible transactions:
      - **https://en.bitcoin.it/wiki/Irreversible_Transactions**
      - **https://coinsutra.com/bitcoin-double-spending/**
      - **https://www.investopedia.com/ask/answers/061915/how-does-block-chain-prevent-doublespending-bitcoins.asp**
    - How Blockchain significantly reduces the amount of time to not just process transactions but to clear settlements.
      - **https://medium.com/@openfinance/wysiwyg-for-clearing-settlements-using-blockchain-technology-to-revolutionize-trading-cf91405e072d**
      - **https://techcrunch.com/sponsored/international-realtime-payments-closer-than-you-think/**
      - **https://www.forbes.com/sites/larrymyler/2017/11/09/transparent-transactions-how-blockchain-payments-can-make-life-easier-for-b2b-companies/#326097f970b5**
- Emergence of ICO's as a means of funding Blockchain start-ups.
  - It may be very useful to introduce this statement by presenting/discussing how start-ups, particularly tech start-ups, have gone through a fairly standard series of venture capital funding phases: angel/seed funding, Round 1, Round 2, etc, and how equity was distributed among shareholders accordingly. This will prime the learners to be able to apply the venture capital approach to funding with the starkly different capitalization alternative provided by ICOs.

- Definition of an ICO from Investopedia:
  - 'An unregulated means by which funds are raised for a new cryptocurrency venture. An Initial Coin Offering (ICO) is used by start-ups to bypass the rigorous and regulated capital-raising process required by venture capitalists or banks. In an ICO campaign, a percentage of the cryptocurrency is sold to early backers of the project in exchange for legal tender or other cryptocurrencies, but usually for Bitcoin.'
    - **https://www.investopedia.com/terms/i/initial-coin-offering-ico.asp#ixzz5OvFd6mFN**
  - Definition of ICO from Wikipedia:
    - **https://en.wikipedia.org/wiki/Initial_coin_offering**
  - Comparing ICOs to traditional Venture Capital funding models:
    - **https://cointelegraph.com/ico-101/ico-vs-venture-capital-what-is-better-for-your-company**
    - **https://www.cnbc.com/2017/08/09/initial-coin-offerings-surpass-early-stage-venture-capital-funding.html**
  - There are plenty of good articles and references for ICOs on the internet, and new stories and relevant case studies are published daily. Since this aspect is evolving so rapidly, it is suggested that the educator research the internet for the most recent case studies around ICO successes and challenges that they think their learners might relate to easily.

Outcome 2: Explain the operating principles of Blockchain.

The skills and knowledge covered in this outcome are generally more complicated than those in Outcome 1, given the challenges of mastering the myriad of technical concepts of how the processes of Blockchain management are carried out. To assist in facilitating the learning of these concepts, it is important for the learner to have a concrete mental model of how the end-to-end process works in serial and parallel modalities. It could be very challenging for learners to fully understand and be able to transfer the knowledge around applying Blockchain in Outcome 3 without fully understanding the operating principles addressed in this outcome.

With regard to some of the specific knowledge to be covered in this unit, the information below may be useful to educators:

- Centralised and decentralised ledgers.
  - Given that some learners may have no prior experience or knowledge about accounting principles, it may be helpful to introduce this statement by defining what a ledger is eg, a book of records of all the financial transactions within an organisation. Provide examples of the type of information typically stored in a ledger: goods purchased, properties transferred, contract details, etc, as a means for contextualising the general use for a ledger.
  - The definitions of both of these types of ledgers (centralised and decentralised) are easily located on several of the previously mentioned references, but the key point for learners is that traditional database technology had a centralised ledger — decreasing transparency and increasing the likelihood of fraud/corruption due to a single point of failure — and the decentralised ledgers of Blockchain and other DLTs (distributed ledger technologies) maximise transparency and minimise the likelihood of fraud/corruption *via* distributed copies of the ledger being maintained in a governed manner across its respective peer nodes.

- References comparing the two ledger types:
  - **https://medium.com/@shyamshankar/centralized-ledgers-vs-distributed-ledgers-layman-understanding-52449264ae23**
- Permissioned vs permissionless ledgers.
  - In the broadest terms, permissionless ledgers are completely open and transparent to all stakeholders in the Blockchain (common for most cryptocurrency-based Blockchains) and permissioned ledgers allow for point-to-point 'channels' to be created (eg, as in the supply chain) that only allow members of the Blockchain to see the blocks and corresponding transaction data that they have the permission to view.
  - References and articles on permissioned vs permissionless ledgers:
    - **https://bornonjuly4.me/2017/01/10/blockchain-what-is-permissioned-vs-permissionless/**
    - **https://medium.com/@akadiyala/nuances-between-permissionless-and-permissioned-blockchains-f5b566f5d483**
- Characteristics of a Blockchain
  - Uses cryptography to ensure privacy and security of transaction data.
  - Very difficult and expensive to change or manipulate the data that it stores.
  - It stores data in blocks (each containing information on one or more transactions).
  - The distributed ledger for the Blockchain is managed by several members of the Blockchain referred to as nodes or peer nodes.
  - There must be a consensus of the validity of a new block agreed upon by the peer nodes prior to block being added to all the ledgers in a Blockchain.
- Blockchain standards including what constitutes a block.
  - A block in a Blockchain consists of an index, a hash, some data, hash of the previous block in the chain, the timestamp it was created, and a difficult to solve puzzle (used in the proof of work approach).
  - The International Organization for Standardization (ISO) currently has 10+ international standards in development for Blockchain (ISO/TC 307) covering everything from ontological standards to standards on governing legally binding contracts via smart contracts:
    - **https://www.iso.org/committee/6266604/x/catalogue/p/0/u/1/w/0/d/0**
  - It is important that the educator research updates to the development of Blockchain standards as this area is rapidly evolving. Some vendor-specific consortia, such as the Enterprise Ethereum Alliance, are developing their own Blockchain standards that conflict somewhat with the scope and tenor of the independent standard consortia that are also attempting to address the space of Blockchain standards.

- Importance of cryptography as a security provider for Blockchain.
  - Assuming this concept may be new to most learners, a general definition and introduction to the concept of cryptography should be carefully considered before positioning cryptography as a specific component of Blockchain.
  - Given that the Blockchain uses SHA256 cryptography, it may be a helpful exercise to have learners go to an SHA256 generator site such as **https://passwordsgenerator.net/sha256-hash-generator/** to see cryptography in action and encourage them to use this encrypted approach to creating passwords to be more secure online.

- — Explain the difference between private and public keys:
  - – **https://support.blockchain.com/hc/en-us/articles/360000951966-Public-and-private-keys**
  - – **https://coinsutra.com/bitcoin-private-key/**
- — Revisit the role of the crypto hash in the architecture of a block — it has its own hash that is generated by hashing its index, timestamp, and the hash of the previous block — and contains the hash of the previous block in the chain.

♦ Roles in a Blockchain system, including regulator and certificate authority.

- — **Regulator —** regulates the industry in a manner similar to the way regulators have historically. Could play a major role in terms of how the Blockchain is governed.
- — **Certificate authority (CA) —** the centralised certificate authority for a Blockchain that stores all the public keys of users within a Blockchain as part of a Public Key Infrastructure (PKI) approach to secure records within a Blockchain. CAs ensure that those participating in Blockchain eg, a bank, are who they say they are using the certificate standard X.509.
- — **Blockchain solution architect —** designs the Blockchain solution and oversees the development of the solution.
- — **Blockchain solution engineers ('developers') —** develops the applications and smart contracts under the guidance of the Blockchain solution architect.
- — **Blockchain network administrator —** similar to the existing role of a network administrator – ensures that all the myriad components of the Blockchain solution are maintained and working properly.

♦ Types of security provided by Blockchain, including new block verification processes.

- — Although there are many security benefits of the security provided by Blockchain — with various levels of complexity and sophistication — below are the three main types of security provided by Blockchain solutions that fall within the intended scope of this unit:
  - – The architecture of the Blockchain itself provides security as **each new block is linked to the previous block** in a verifiable and nearly immutable manner. This makes it extremely difficult to change an individual piece of data recorded in the Blockchain.
  - – Access to the Blockchain is secured through a cryptographic scheme that **requires users to use a private key to sign their transactions** with. If any record of their transaction is ever altered, their signature becomes invalid and thereby alerting all the members of the peer network that there is something wrong.
  - – The distribution of ledgers across multiple networks means that even if a hacker were to successfully alter a record in one ledger (highly unlikely) this change would still have to be accepted via consensus through the **block verification process** by the other peer nodes — also highly unlikely and prohibitively expensive.

- Peer nodes and how they fit in the Blockchain governance model.
  - The distributed ledgers of a Blockchain are each individually managed by a peer node on a series of different servers. When a user attempts to add a new block to a Blockchain (which may or may not require the initial validation of the transaction by a third party such as a bank) it must be accepted by a minimum consensus of 51% before a block is added to all the ledgers managed by all of the peer nodes.
  - Slightly advanced concept — peer nodes can get information stored in other peer nodes through standard HTTP protocols. This allows peer nodes to see, list, and retrieve the blocks store in other peer nodes for purposes of validation and resolving issues when there are blocks of different lengths in different ledgers. This topic is covered more in-depth in the Level 8 *Blockchain* unit.

Outcome 3:

The overarching goal of this outcome is to prime the learners to understand how Blockchain is currently being applied in the real world including the general applications such as cryptocurrency and smart contracts as well as the sector-specific applications such as operationalizing and enforcing legal contracts via smart contracts and the implications for supply chain management. Upon mastery of this outcome, learners should be capable of carrying on professional conversation about what Blockchain is, how does it work, and how it is being used today and how it may be used tomorrow.

With regard to some of the specific knowledge to be covered in this unit, the information below may be useful to educators:

- Applications of Blockchain in financial services (eg, fintech), cross-border finance, government, supply chain management. healthcare and the internet of things.
  - Examples of Blockchain applications in these areas are easily available via researching searching for examples on the internet. Given how rapidly these use cases are evolving, it is recommended to research new case studies for every term this content is delivered to keep it relevant.
- Role of smart contracts in the operationalizing of business processes in the Blockchain
  - If this is the first-time smart contracts are being introduced to the learners, seriously consider providing a basic definition of the concept of smart contracts such as the following definition from Investopedia:
    '***Smart contracts*** *are self-executing* ***contracts*** *with the terms of the agreement between buyer and seller being directly written into lines of code. The code and the agreements contained therein exist across a distributed, decentralized* ***Blockchain*** *network.'*
  - Key smart contract use cases:
    - **Identity management —** Enabling individuals to own and control their personal identity, data, digital assets and reputation.
    - **Record management and automation —** Automatically digitizing, filing, renewing, and releasing records.
    - **Operationalising and enforcing legal contracts —** Converting traditional monolithic contracts into a series of modular self-executing and self-governing smart contracts.
    - **Eliminating the middle man in transactions —** Digitising workflows that used to involve several middle men and intermediate parties can be eliminated making transactions faster and less expensive.

  - **Product provenance and tracking —** Tracking products throughout their lifecycle in the supply chain where each party in custody can log evidence about the product.

- Cryptocurrency concepts and types, including Bitcoin and Scotcoin.
- If this is the first-time cryptocurrencies are being discussed at length, carefully consider providing a basic definition of the concept of cryptocurrency, such as the following definition provided by Investopedia:
  'A cryptocurrency is a digital or virtual currency that uses cryptography for security. [...] A defining feature of a cryptocurrency, and arguably its most endearing allure, is its organic nature; it is not issued by any central authority, rendering it theoretically immune to government interference or manipulation.'
- There are several excellent overviews on cryptocurrency in some of the previously referenced resources in this document such as Investopedia and the Bitcoin Wiki.
- This overview of cryptocurrency is written at the level appropriate for the intended audience of this unit: **https://blockgeeks.com/guides/what-is-cryptocurrency/**
- A well-maintained list of all known cryptocurrencies can be found here: **https://coinmarketcap.com/all/views/all/**
- Up to date information on the Scotcoin project can be found here: **https://scotcoinproject.com/**
- Cryptocurrency wallets should be introduced where feasible as a common means of buying, selling, storing, and using cryptocurrency.
  - Cryptocurrency wallet overview: **https://blockgeeks.com/guides/cryptocurrency-wallet-guide/**
  - Bitcoin wallet overview: **https://www.investopedia.com/terms/b/bitcoin-wallet.asp**
  - How to use your cryptocurrency wallet: **https://medium.com/@Crowdwiz.io/how-does-a-cryptocurrency-wallet-work-and-how-to-create-one-f234c6ec076f**
- The comparison of cryptocurrency exchanges vs traditional stock market exchanges should be addressed time permitting. This is one of several good comparisons available online: **https://cryptoslate.com/crypto-exchanges-vs-stock-exchanges-how-do-they-compare/**
  - Benefits and challenges of Blockchain compared to traditional database technology.
- It is recommended to introduce this topic by deepening the comparison between Blockchain and traditional database technologies. A very basic reference on the topic that compares the key features of each head to head:
  https://www.multichain.com/blog/2016/03/blockchains-vs-centralized-databases/
- This topic should be used to reinforce the unique attributes and challenges of Blockchain
  - How decentralized applications (dApps) leverage the blockchain to expedite app development.
- It is recommended to begin this topic by defining dApps — decentralized applications (apps) that runs on the Blockchain.
- Differentiate from smart contracts — dApps perform several functions with several participants for both buyers and sellers where smart contracts tend to be more transitionally oriented between two parties eg, party A wants to sell item C to party B.
- Key attributes of all dApps:
  - **Open source —** Source code of app is available to all.
  - **Decentralised —** Uses a Blockchain-like cryptographic technology.
  - **Incentive —** App has crypto-tokens/digital assets for fuelling itself.
  - **Algorithm/protocol —** Generates tokens and has an inbuilt consensus mechanism.

- Since the Blockchain already exists, dApp developers do not have to worry about building out their own underlying data structure, leaving them with just the business layer of the app to develop, greatly decreasing development time.
- Key considerations for implementing Blockchain.
- The complexity of this topic should be adjusted to the career goals and interests of the learners.
- A good sample inventory to work from for creating an outline for a Blockchain implementation strategy: **https://vitalflux.com/blockchain-architects-top-15-project-implementation-considerations/**

Guidance on approaches to delivery of this unit

The outcomes in this unit should be delivered and assessed in the order provided in this document; ideally with a demonstration of knowledge by the learner in one outcome before being allowed to proceed to the following outcome.

It is recommended that a small group approach be utilised by applying the principles of differentiated teaching: learners with strong technical skills and background could be paired with learners with less experience and skills. Likewise, more extroverted learners, who may be more comfortable presenting in a classroom environment, could be paired with learners who may be less comfortable, etc. Learners within the group should collaborate to build and deliver presentations demonstrating their mastery of the knowledge covered within the unit. More advanced learners should be assigned research activities on advanced topics and be required to present their findings to the rest of the class.

For addressing the statement '*Key considerations for implementing Blockchain*' in Outcome 3, it is recommended that, where feasible, the learners are assigned a capstone project of building a high-level business plan that demonstrates not only an understanding of what goes into a plan for implementing a Blockchain solution, but additionally demonstrates that they can apply and transfer the knowledge on existing Blockchain implementations and other topics covered in Outcome 3. In the right context, this activity can be completed in a small group, with each member of the group playing a unique role: PowerPoint creator, researcher, graphics and media specialist, writer, business analyst, presenter/sales, etc, to further enforce employment readiness skills.

Suggested distribution of time across all outcomes

Although the actual distribution of time may vary based on the rate that a given cohort group progresses and demonstrates mastery within an outcome, the following represents the intended temporal commitments for this unit:

- Outcome 1: 12 hours
- Outcome 2: 12 hours
- Outcome 3: 16 hours

Summative assessment may be carried out at any time. However, when testing is used (see evidence requirements) it is recommended that this is carried out towards the end of the unit (but with sufficient time for remediation and re-assessment). When continuous assessment is used (such as the use of a web log), this could commence early in the life of the unit and be carried out throughout the duration of the unit.

There are opportunities to carry out formative assessment at various stages in the unit. For example, formative assessment could be carried out on the completion of each outcome to ensure that learners have grasped the knowledge contained within it. This would provide assessors with an opportunity to diagnose misconceptions and intervene to remedy them before progressing to the next outcome.

Guidance on approaches to assessment of this unit

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners and may vary greatly from one cohort of learners to the next.

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

Assessments on knowledge evidence could be achieved by a combination of:

1 An evidence-based assessment utilising the differentiated teaching methods described above (requiring the learners to create and present presentations to the class demonstrating their knowledge mastery).
2 Traditional multiple-choice assessments. In some circumstances, it may be more practical to carry out the entirety of the knowledge assessment with a traditional multiple choice-based approach.

If evidence-based assessment is used by way of presentations, educators should have a checklist/pro-forma to mark the evidence of small group and individual presentations. The checklist should account for elements such as: thoroughness of content, accuracy of content, sequencing of content, appropriate levels of sophistication, originality, sourcing of references, and overall quality of the delivery of the presentation.

If a multiple-choice assessment were carried out, this could be an online or paper-based selected-response test comprising 30–40 questions with one correct response and three distractors for each question. The test should cover all the knowledge statements across all three outcomes, with at least one question for each statement. A pass mark of 60% should be set.

An alternative approach to assessment would involve the use of a blog to record learning (and the associated activities) throughout the life of the unit, as opposed to the group and individual presentation approach previously described. The blog would provide knowledge evidence in the descriptions and explanations provided in each learner's posts. The blog should be assessed using defined criteria to permit a correct judgement about the quality of the digital evidence. In this scenario, every knowledge and skill must be evidenced; sampling would not be appropriate.

Formative assessments should be administered frequently to allow the educator to gauge the overall level of mastery of every topic for the entire learner cohort group.

Summative assessments should be administered upon completion of instruction for each outcome and could also be administered, or simply complemented, by the blog-based approach described above. Given the foundational progression of the outcome sequence, a summative assessment demonstrating mastery of Outcome 3 could serve as enough evidence of mastery of the entire unit, especially when administered as an evidence-based assignment encompassing the knowledge addressed across all outcomes.

Learners should be encouraged to complete formative assessments in a closed-book manner then use any books or reference materials for the course for checking their responses. Learners should be able complete formative assessments at any time and repeat them as often as needed. In some instances, educators may want to collect learner responses to formative assessment for the purposes of gauging the overall master level of the cohort group as mentioned above. In addition to this traditional approach to formative assessment, learners may also achieve the same outcomes and provide the same level of gauging for educators via the blog-based approach.

Traditional multiple-choice summative assessments should be delivered under supervision by appropriate staff in a closed-book environment. For the evidence-based summative assessment approach, learners would be allowed to either work on their own or in groups AND outside the classroom to create their presentation. If a blog is used for summative assessment, it would also facilitate formative assessment since learning (including misconceptions) would be apparent from the blog, and remediation could take place to correct misunderstandings on an on-going basis.

Where possible and practical, learners should be provided with the opportunity to present their knowledge directly to the rest of the class, either via in-classroom discussions and presentations or via their blog posts.

Opportunities for e-assessment

E-assessment may be appropriate for some assessments in this unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the evidence requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at **www.sqa.org.uk/e-assessment**

Opportunities for developing Core and other essential skills

The concepts related to Blockchain technology present a rich sandbox for developing and applying the skills essential to computational thinking. The diversity of process types and systems that work together to support the Blockchain can be complex, so it is important to reinforce computational thinking techniques as learners progress through this module to prime them for application and transfer of this knowledge in a meaningful and practical manner.

Higher National Unit Support Notes (cont)

Unit title: Blockchain (SCQF level 7)

Specific examples of opportunities to develop computational thinking in this unit:

- **Abstraction —** understanding Blockchain processes requires learners to think abstractly and to operate simultaneously on multiple layers of abstraction to master the principles and corresponding processes related to Blockchain.
- **Decomposition —** given that Blockchain transactions and solutions have many discrete components that work together in a system-based manner, learners will be required to think and communicate about Blockchain in a decomposed collection of largely independent and specialised technologies and processes.

The principle recommended design for delivering this unit, small group/differentiated instruction, will provide learners with an opportunity to develop a wide variety of employment and other critical soft skills:

- Teamwork and collaboration skills
- Communication skills
- Problem-solving skills
- Reading for information skills
- Locating information skills
- Observation skills

History of changes to unit

Version	Description of change	Date

General information for learners

Unit title: Blockchain (SCQF level 7)

This section will help you decide whether this is the unit for you by explaining what the unit is about, what you should know or be able to do before you start, what you will need to do during the unit and opportunities for further learning and employment.

The purpose of this unit is to provide you with the knowledge required to understand, communicate, and apply the basic concepts of Blockchain and establish the foundation required to pursue more technical skills and knowledge in Blockchain and other related areas, such as financial services (fintech), computer programming, IT, and cyber security.

In terms of employment skills, this unit will equip you with a valuable knowledge and skills in this rapidly evolving and disruptive emerging technology that is in historic demand in the marketplace.

Throughout the delivery of this unit, you will be engaged in individual and group activities aiming to provide you with a variety of opportunities to perfect, apply and assess your knowledge. These activities might include small group-based collaboration in building and delivering presentations on important concepts, as well as individual assignments based on your personal interests and/or skill level.

Upon successful completion of this unit, you will be able to:

1 Describe the development of Blockchain and define its most essential components.
2 Explain the operating principles of Blockchain and how transactions are processed from individual records to blocks contained across a distributed network.
3 Describe the current applications of Blockchain in a manner that is relevant to employers and other Blockchain professionals.

At key points within each outcome, you will be presented with opportunities to assess the knowledge and skills you have gained. This assessment may take the form of a group or individual-based presentation or a traditional multiple-choice closed-book assessment.

Throughout this unit you will have an opportunity to develop a wide variety of employment and soft skills in the following areas:

- Teamwork and collaboration
- Communication
- Problem-solving
- Reading for information
- Locating information
- Observation

Once you have completed this qualification, if you wish to continue building your knowledge in Blockchain and better prepare yourself for a more technical job role in Blockchain, you could progress to the unit in *Blockchain* at SCQF level 8. You may also wish to consider undertaking the HND in Cyber Security.