GBA

Government Blockchain Association

Blockchain Consulting Series Course Handbook

Education & Training Working Group

Version 1.9

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Table of Contents

Appendixes

A Acknowledgements

1 Introduction

1.1 Purpose and Scope of the GBA Course Handbook

The Blockchain Consulting Series Course Handbook provides certified GBA training providers, which includes course designers and instructors, with a consistent content structure for developing GBA-compliant training materials and assessment tools to facilitate GBA training certifications.

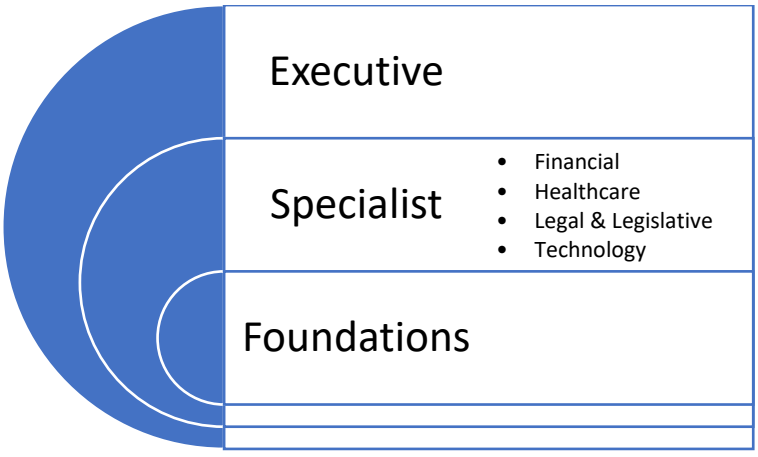
1.2 Distribution and Approvals

The GBA Blockchain Consulting Series Course Handbook is intended to be shared with the Education & Training Working Group, GBA Chapter Leadership, and GBA Certified Training Providers. As blockchain technology rapidly evolves, the GBA Blockchain Consulting Series Course Handbook is a living document and will be updated on a regular basis. GBA training providers and GBA chapters are required to update their training materials to reflect the changes within the GBA Blockchain Consulting Series Course Handbook. All substantive changes to GBA training material must be approved by the GBA Executive Director, GBA Director of Training Programs, or any authorized GBA Training Program Team Member.

1.3 GBA Blockchain Certifications

The GBA certification program is organized into three levels of courses. They are:

- Blockchain Foundations
- Blockchain Specialists, and
- Blockchain Executive Consultant



There are multiple specialist courses and they are independent of each other. However, the Foundations course is a prerequisite to all the Specialist courses.

1.4 The Prerequisite Nature of the Courses

While all three courses are independent, each level course is a prerequisite for the higher-level course. For example, in order to register for the Blockchain Executive Consultant Course, the participant must complete the Blockchain Foundations Course and a GBA Blockchain Specialist Course (Each working group may establish their own domain specific blockchain specialist course). Prerequisites for certifications are valid for a three-year period.

1.4.1 Recognition

For each course completed, the participant will be recognized within the GBAGlobal.org web site. As soon as the GBA blockchain certification is operational, GBA certifications will be posted on an active blockchain platform.

1.4.2 Validation Period

Each GBA Blockchain Certification is valid for three (3) years.

1.5 Consulting Series Course Goals

The purpose of this series of courses is to impart attendees with the knowledge and capability to provide consulting services to organizations to incorporate blockchain solutions into their current and future business models. Participants will

- Become familiarized with the basics of cryptocurrencies and blockchain technology.
- Describe how blockchain technology can be used in a wide variety of use cases and situations in many different domains.
- Understand blockchain protocols and technical security requirements.
- Recognize the legal and regulatory framework related to blockchain technology.
- Appreciate the architectural and technical issues that must be considered before launching a blockchain development initiative.
- Review use-cases and lessons learned from previous blockchain projects.
- Create a blockchain solution model project for an enterprise.

1.6 Course Structure

The course is organized into learning objectives (lessons).

1.6.1 Blockchain Foundations

Lesson 1: Introduce the history of bitcoin and blockchain technology.

Lesson 2: Discuss why cryptocurrencies and blockchain technologies are important.

Lesson 3: Provide a basic understanding of cryptocurrencies.

Lesson 4: Provide a basic understanding of blockchain technology.

Lesson 5: Introduce legal and regulatory considerations.

Lesson 6: Discuss blockchain use cases

1.6.2 Blockchain Technical Specialist

Lesson 1: Collect requirements for a blockchain based solution

Lesson 2: Understand design options, and considerations to make technical decisions

Lesson 3: Understand development platforms to determine platforms and tools

Lesson 4: Understand the testing parameters, and constraints to plan, and test blockchain systems

Lesson 5: Understand and implement post-production controls and support mechanisms

Lesson 6: Be able to transform a concept into a blockchain solution

1.6.3 Blockchain Healthcare Specialist

Lesson 1: Healthcare Megatrends & Introduction to Blockchain

Lesson 2: Healthcare – The Big Picture

Lesson 3: Clinical Trials Management

Lesson 4: Data Management/Access/Control + Consent Management

Lesson 5: Drugs Supply chain & Anti-Counterfeiting

Lesson 6: Insurances (Claims Management/Frauds Reduction)

Lesson 7: Improving Administrative Processes

Lesson 8: Value-Based Healthcare System

Lesson 9: New Business Models in Healthcare and the Role of Tokenization
Lesson 10: From Acute Care to Prevention – The Role of Blockchain in 4Ps Medicine
Lesson 11: Regulatory Such as HIPAA & GDPR
Lesson 12: Technical Implementation & Challenges
Lesson 13: Business Challenges
Lesson 14: Cultural Challenges

1.6.4 Blockchain Legal Specialist

Lesson 1: Introduction
Lesson 2: Blockchain & Cryptocurrency
Lesson 3: Core Government Functions
Lesson 4: Blockchain Legal Considerations
Lesson 5: Legal & Regulatory Framework

1.6.5 Blockchain Financial Specialist

Lesson 1: Redefining Money
Lesson 2: Money, Inflation & Debt
Lesson 3: Retail Banking
Lesson 4: Central Banking
Lesson 5: International Organizations / Non-Government Organizations
Lesson 6: Tokenomics & Crypto-Governance

1.6.6 Blockchain Executive Consultant

Lesson 1: Business Strategy
Lesson 2: Refresher on Blockchain Foundations & Technology Courses
Lesson 3: Government & Regulatory Considerations
Lesson 4: Business Use Case Summary
Lesson 5: Blockchain White Paper
Lesson 6: Business Case Discussion
Lesson 7: Future of Blockchain

1.7 Course Wrap Up

Upon the completion of every course, the instructor sends the GBA Training Director a list of students that have completed the course along with their full name, email address, location (city, state/province/country and postal code). Also, include the name of the instructor, course dates and location of the course. Let students know that if they are GBA members, they are GBA members, their credentials will be posted on the GBA website.

2 Course Series Learning Objectives

2.1 Blockchain Foundations Course

The purpose of this course is to provide students with a fundamental understanding of the technology and potential use cases. The instruction learning objectives for this course are:

- Introduce the history of bitcoin and blockchain technology.
- Discuss why cryptocurrencies and blockchain technologies are important.
- Provide a basic understanding of cryptocurrencies.
- Provide a basic understanding of blockchain technology.
- Introduce legal and regulatory considerations.
- Discuss blockchain use cases, benefits, and risks.

2.1.1 Introduction to Blockchain & Cryptocurrencies

2.1.1.1 Why Blockchain is Important

Engage with students to describe why blockchain is important. Key discussion points should include:

2.1.1.1.1 Global Adoption

Discuss how blockchain is being deployed in countries around the world.

2.1.1.1.2 New Solutions to Old Problems

Describe how blockchain technology can improve the efficiency and effectiveness of domains including:

- Land Titling
- Healthcare
- Voting
- Identity Management
- Supply Chain

- Transaction Processing
- Account Reconciliations

2.1.1.1.3 Disruption

Describe how blockchain technology will disrupt organizations and institutions. Considerations should include:

- How will mass adoption of cryptocurrencies impact financial systems
- How will blockchain disintermediate industries?

2.1.1.1.4 Introduces New Risks

Explain how blockchain may make it easier for terrorists, and criminals to conceal illegal activity and how money laundering and other nefarious activities could be hidden from law enforcement. Describe the technical risks, unmet expectations, loss of investment and all of the potential challenges from an uncertain regulatory environment to a loss of global competitiveness and many other potential risks.

2.1.1.2 Blockchain History

Describe to students that blockchain is not new. Let them know that blockchain is a point on the technology and economic timeline. Money and technology have been evolving. They have not ended with the current state. This is just a point on a line, and they will continue to change. Maybe faster in the future, then in the past.

2.1.1.2.1 What is Money?

Describe a brief history of money and the attributes and properties that define currency. Money serves as a:

- Medium of exchange
- Measure of value
- Standard of deferred payment
- Store of value

2.1.1.2.2 Financial Crisis of 2008

Describe the economic, political and societal conditions that led to the 2008 financial crisis. Describe how financial institutions became over leveraged, and how people lost their trust and confidence in large financial institutions.

2.1.1.2.3 Bitcoin White Paper

Describe the white paper that Satoshi Nakamoto posted. Describe the basic tenants and early history of bitcoins.

2.1.1.2.4 Early Adoption

Describe how the early adopters traded worthless tokens until May 2010, when Laszlo Hanyecz made the first real-world transaction by buying two pizzas in Jacksonville, Florida, for 10,000 BTC. Then describe how bitcoin, the first blockchain based cryptocurrency grew in popularity, value and utility globally over time.

2.1.1.2.5 Blockchain Family Tree

Describe how disagreements in blockchain foundations (like scripting languages and technical parameters) let to forks off of the original blockchain (bitcoin). Describe some of the early forks and illustrate some of the reasons why some of the early blockchains branched off into new blockchains. Consider using www.CoinMarketCap.com to demonstrate the vast array of blockchains, tokens and cryptocurrencies.

2.1.2 Blockchain Fundamentals

Explain how the blockchain works with a cryptocurrency focus. Explain that a blockchain is a digital ledger in which transactions are recorded chronologically and available to blockchain participants. People all over the world are using blockchain-based vendor or open source products. One of the most common use of blockchain technologies is cryptocurrencies. However, there are many other uses of blockchain technology. Ensure that the students understand what the technology is and why it enables new capabilities that were not possible before.

Topics Include:

- Blockchain types
- Blockchain platforms
- Blockchain facts vs. myths

2.1.2.1 Blockchain Features

Discuss the features of blockchain technology. They include:

- **Security:** Granted permissions along with the use of cryptography prevent unauthorized access to the network.

- **Privacy:** Source identity and transaction content is protected via cryptography and data partitioning practices.
- **Distributed:** The shared ledger is continually updated with each transaction and replicated among the participants for their access.
- **Decentralized Systems:** Required for a blockchain
- Transparency: All participants, contingent on their rights, have access to all transactions processed via the network.
- **Consensus:** Transactions are validated by participating nodes.
- **Cryptographically safe & secure ecosystem**
- **Immutable Transactions –** Systems only allow information to be added, not modified or deleted.

2.1.2.2 Technological Components

Explain how blockchain technology is a configuration of other technologies that have been in use for over ten years. However, the unique combination of these technologies enables new blockchain capabilities. Describe the technological components of blockchain technology including:

- Distributed Database Technology
- Hash Function – Describe how it works
- SHA-256 Encryption – Recommend this video: www.youtube.com/watch?v=S9JGmA5_unY
- Merkle Tree

Describe how blockchain is a block of transactions that are cryptography sealed and linked using cryptographic hashes.

Also describe how blockchain protocols, platforms and products are layered and the interrelationship between them. It is important to emphasize that some blockchains have associated currencies and tokens and other blockchains do not.

2.1.2.3 Blockchain Protocols

Ensure that students understand why blockchain technology is different from previous technologies, and why it is appropriate for the transference of value. Blockchain protocols are like internet protocols. Where the internet protocol enabled the peer-to-peer movement of information, the blockchain protocol enables the peer-to-peer movement of value.

A protocol that defines an architecture. Internet protocols such as TCP/IP and HTTP are a set of rules that all computers on the network use so that people can share information without a third party. A blockchain protocol is a set of rules that computers use to transfer the ownership of digital assets between

peers without requiring a third-party intermediary to validate or facilitate each transaction.

2.1.2.4 Example Blockchain Protocol (Bitcoin)

Students should be taught the basic concepts, as cited below, of the bitcoin blockchain. They should also be informed that this is just one example. But it is illustrative of basic blockchain attributes. The illustration should describe a bitcoin transaction and include the following sequence of events.

- Transaction initiation and viewing on the blockchain.
- Transactions bundled into a block.
- Miners guess the correct nonce and receive block rewards (i.e., for proof of work or other consensus algorithms).
- The amount of guessing required to find a nonce small enough is periodically adjusted, after a number of block formations, to ensure a sufficient amount of time is needed.
- Nodes employ the rules of the blockchain to confirm the nonce is valid.
- The miner adds the new block, which connects to the immediately preceding block of the blockchain.
- The new block is distributed to all the nodes on the bitcoin network.

Note: Other types of blockchain technologies are presented during the Blockchain the technology specialist course. For instance, in other distributed ledger technologies, transactions may not be organized into blocks.

2.1.3 Blockchains Use for Movement of Value

Describe how blockchains can be used to move value among untrusted parties. Describe the various forms that value can take including:

- Tokens
- Securities
- Currencies

Also describe the environment / eco system needed to move value including:

- Technology Framework
- Business Framework
- Economic Framework (Tokenomics)
- Regulatory Framework

2.1.3.1 Forms of Value

Explain how blockchains use digitized representations of value to process the transference of value from one owner to another (and avoid the double-spend problem). Digitized representations of value typically take the form of tokens, securities or currencies.

2.1.3.1.1 Tokens

Describe how tokens are used within a closed community. They typically are not exchanged for currency and they represent a service or value within a closed community. Rewards programs are examples of tokens.

2.1.3.1.2 Securities

Securities are typically an asset that is expected to appreciate in value. It will often times appreciate in value completely independent of the owner of the asset causing it to increase in value. A stock in a company is an example of a security.

2.1.3.1.3 Cryptocurrencies

Describe how there are many different cryptocurrencies and how each one has different technical and performance parameters. The block times, transaction volumes and transaction costs all factor into the tokenomics (supply & demand).

2.1.3.2 Tokenomic Ecosystem

Explain how in order for a blockchain token to establish and maintain economic value and potentially appreciate in value, an infrastructure is needed.

2.1.3.2.1 Technology Framework (Wallets & Exchanges)

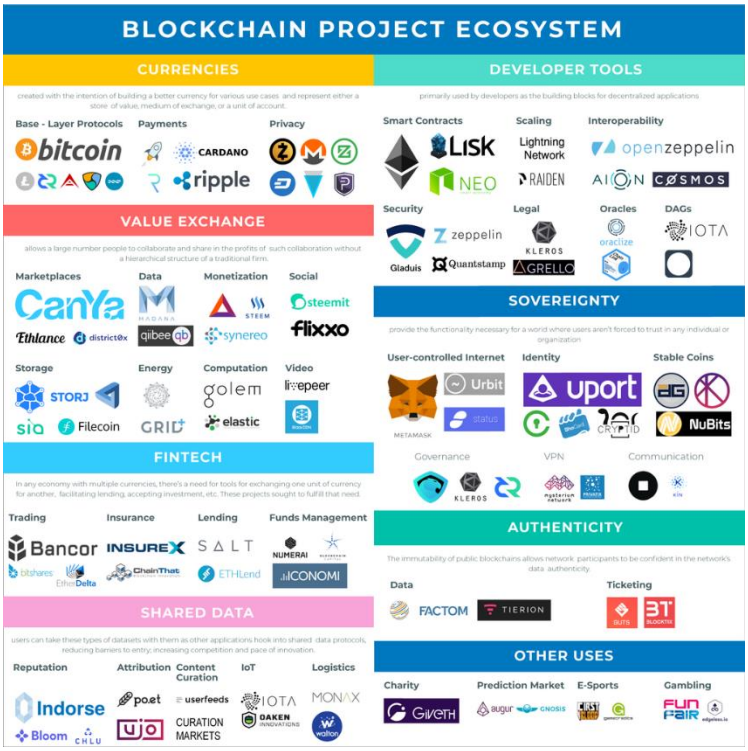
Explain how the movement of value requires wallets and exchanges in order to hold and transfer tokens. Explain the types of wallets and exchanges. Describe the difference between a wallet and exchange. Specifically address the types of wallets including:

- Hosted (online)
- Hardware
- Software / Desktop
- Paper

Also describe the types of exchanges (distribute and private). Please describe the advantages and disadvantages of each type of wallet/exchange

2.1.3.2.2 Organizational Framework

Governance Organizations - Explain how for tokens to survive over a period of time, there must be some mechanisms established to monitor, influence and control aspects of the blockchain. The mechanism may include managing the supply, distribution and technical parameters of a blockchain. These organizations may include foundations, associations or private companies. They may be centralized or decentralized.



Service Providers – As an ecosystem matures, service providers are required to support the ecosystem. These may be public, private or distributed organizations that provide wallets, exchanges, insurance, information & advisory services. Professional services including accounting, engineering, legal, marketing, and many others are required to mature a blockchain ecosystem.

2.1.3.2.3 Regulatory Framework

Explain that in order for a blockchain system to survive, it must be compliant with legal, statutory and regulatory requirements. The regulatory environment spans a wide spectrum of topics including topics such as security, privacy, record retention, securities law, tax codes, reporting requirements and anti-money laundering requirements. Requirements also imposed at a variety of levels including:

International, Regional, National, Provincial (State), and Local government authorities.

Describe the nature and extent of legal and regulatory requirements on the transference of value on a blockchain.

2.1.4 Introduction to Smart Contracts

Explain that one of the first forks off of the bitcoin blockchain was Ethereum. The fork resulted in a desire by some people to include scripting language within the protocol that would allow for software code (called smart contracts) to determine time, transaction amount and participants in token transactions. Ethereum established a protocol to manage change requests called the Ethereum Request for Change (ERC). Tokens can now be created using an appropriate ERC protocol. ERC20 is the most common protocol used to create new tokens.

2.1.5 Using Cryptocurrency, Tokens, Coins & Ledgers

Describe how blockchains are just a mechanism to transfer value represented by cryptocurrency, tokens, coins and ledger entries. However, it is the way that they are being used that is new.

2.1.5.1 Cryptocurrency

Explain how cryptocurrency falls into three main categories. They are traditional (hard to think of any cryptocurrency as traditional), Altcoins and privacy coins. Coins created using the ERC20 standard are most commonly used because may exchanges support them. There are also many tools and products that facilitate the development of unique tokens and coins. These tools have caused a flood of thousands of tokens and coins to be created and available for use. www.coinmarketcap.com is a listing of many of these coins. The listing displays them in order and by market capitalization.

The rate of cryptocurrency adoption can be measured by numerous indexes and data sources including www.coinmarketcap.com.

Altcoins are any coin other than bitcoin. Privacy coins are difficult to trace because they mask information about each transaction. Monero and Zcash are examples of privacy coins.

Cryptocurrency adoption is a function of the ease of use, regulatory barriers and inflation considerations (should people spend or hold cryptocurrency). As those barriers become smaller, cryptocurrency will be more widely adopted. This potentially limits visibility and access from financial and law enforcement institutions.

2.1.5.2 *Tokens*

Tokens are digital assets that exist within defined community and context. They hold value, however, only for a pre-defined community. They are typically not exchanged for fiat currency

2.1.5.3 *Coins*

Explain that the ERC20 token standard enabled individuals to create their own token and offer their tokens to the general public. These became known as Initial Coin Offerings (ICOs). Large numbers of people and organizations created coins and made many claims about their potential value. Most coins did not live up to their predicted value. Eventually government regulators clarified that the offering of these coins would be regulated in much the same way as stock offerings.

Describe the Howie test and provide a high-level overview of government regulations including:

- Anti-money laundering (AML)
- Know your customer (KYC)
- Consumer and Investor Protection
- Banking and Financial
- Taxation/Tax Collection
- Privacy Issues
- National Security
- Digital Identity

Note, these requirements may be different in various countries or regions.

2.1.5.4 *Ledgers*

Not all blockchains require the use of a token or coin. Blockchains record bundle of records or transactions. However, a transaction could be an event such as a vote or change in state (Such as a device being turned on or off). In cases like this, their may not be any coin. But there is a still a ledger.

2.1.6 Blockchain Use Cases

Blockchain technology has advanced well beyond the initial bitcoin application as a new form of digital cash. Engage with the students on an exploration of some of the many different ways that blockchain is and can be used in both the public and private sectors. Include other local and international examples.

2.1.6.1 *Government Use Cases*

Topic	Key Points	Reference Information
Acquisition Management	Blockchain along with artificial intelligence (AI) and Robotic Process Automation (RPA) provide new capabilities for acquisition management.	• www.gbaglobal.org/category/topics/acquisition-mgmt
Contract Management	Smart contracts can be used to streamline contract management.	• www.gbaglobal.org/category/contract-management
Cybersecurity	Blockchains can improve security, have risks and should be considered in accordance with the risk management framework.	• www.gbaglobal.org/category/cybersecurity • https://www.gbaglobal.org/resources/categories/security
Intellectual Property	• IP can be hashed and recorded on a blockchain • Blockchain date stamps and records information • Immutable and indisputable	• www.gbaglobal.org/groups/intellectual-property-ip • www.gbaglobal.org/resources/categories/intellectual-property

Topic	Key Points	Reference Information
Land Titling	Blockchain use for land titling is in early stages around the world.	• www.gbaglobal.org/resources/categories/land-titling • www.gbaglobal.org/category/asset-management/land-titling/
Law Enforcement	• Blockchain can be used by both criminals and law enforcement professionals.	• www.gbaglobal.org/resources/categories/law-enforcement • www.gbaglobal.org/category/topics/financial-crimes/
Voting	• Votes would be transparent & immutable • Voting would be rules-based • Immediate visibility into vote count • Recounts not needed	• www.gbaglobal.org/category/topics/voting • www.gbaglobal.org/resources/categories/voting

2.1.6.2 Business Use Cases

Describe how blockchain solutions is and can be used by the private industry.

Topic	Key Points	Reference Information
Banking & Finance	• Major retail banks are using blockchain for	www.gbaglobal.org/category/economic/economic-analysis

Topic	Key Points	Reference Information
	cross-border payment processing • Blockchain is causing significant reviews of traditional business processes	www.gbaglobal.org/resources/categories/banking-financial-industry https://www.gbaglobal.org/category/communities/banking-and-finance-industry/
Healthcare	Healthcare offers many opportunities for blockchain in both the delivery and management of care along with the administration of healthcare spending.	www.gbaglobal.org/resources/categories/healthcare www.gbaglobal.org/category/health-care
Energy	Blockchain can be used for many aspects of energy production and distribution.	www.gbaglobal.org/resources/categories/energy www.gbaglobal.org/category/energy
Supply Chain	Blockchain is an excellent technology to track the status of goods moving through a supply chain.	www.gbaglobal.org/resources/categories/supply-chain www.gbaglobal.org/tag/supplychain
Identity Management	Blockchain can be used to help individuals gain	www.gbaglobal.org/resources/categories/identity-management www.gbaglobal.org/category/identity-management

Topic	Key Points	Reference Information
	additional control over their own identity information.	

2.2 Blockchain Technical Specialist Course

The purpose of this course is to provide students with a well-rounded technical foundation of blockchain technology to aid them in the technical decision-making process. It supports the decisions including:

- Do I need a blockchain?
- What are the factors that I should consider when implementing a blockchain?

2.2.1 Basic Blockchain Considerations

2.2.1.1 Blockchains Can Solve Traditional Problems

Describe how blockchain technology could mitigate some traditional technological issues including:

- **Silo Architecture:** Data resides in varied enterprise systems that independently operate. As a result, data is often duplicated; while in some cases, data is not shared across organizations.
- **Centralized Network:** Over-reliance on a system hub that exerts unilateral control over the data. This centralized platform, a single source of failure or corruption, may cause processing delays due to bottlenecks, and system interruptions.
- **Data Distribution:** When data is disseminated, it must be validated and reconciled among these participants on an ongoing basis – representing significant duplications of effort.
- **Data Timeliness:** Due to data distribution from the hub to systems via set interfaces, data is not often timely available for use. This causes delays in both manual and automated processes.
- **Security:** Data stored at a centralized system is more prone to cyber threats due to this single source. Further, data may be vulnerable due to insufficient encryption and cryptography practices.
- **Visibility:** The lack of visibility by network participants, into the centralized data repositories, causes distrust.
- **Traceability:** Maintained transaction history is not adequate, and is subject to alteration.

2.2.1.2 Do I Need a Blockchain?

Describe why the very first question that should be addressed when considering a blockchain technology is “Do you even need a blockchain?” There are several models that can be used when deciding:

- D. Birch Model

- Birch-Brown-Parulava Model
- B. Suichies Model
- Sebastien Meunier 2017 Model
- IBM Model

2.2.2 Requirements

Both functional and non-functional requirements must be translated into system requirements. While most people understand functional requirements (what the system does), non-functional requirements (how well the system performs) is often neglected. Discuss the types of non-functional requirements that may need to be defined.

2.2.2.1 Tokenization

Explain that tokenization is one of the most important capabilities of a blockchain. Most people associate tokens with speculative coins and ICOs. However, tokens allow for the creation of digital representations for goods, services or rights. This allows trust and values to be exchanged between different parties without the need for a central intermediary.

Describe the various ways that tokens could be used. Provide an example of each.

- Provide access to information about the product they represent
- Grant specific usage rights
- Represent the ownership

2.2.2.2 *Fungible or Non-fungible*

Explain that tokens may be divisible into smaller parts like a unit of currency or associated with an undivided whole entity. For example, a token could represent painting, license or vote.

2.2.2.3 *Smart Contracts*

Discuss how triggers are used to execute a smart contract. Describe potential sources and types of data feeds that could provide objective and trustworthy inputs. Describe the types of transactional responses and how tokens can be used to execute a contract.

2.2.2.4 *Data Storage (Permanent or not)*

Permanent availability of data is the last core requirement of Blockchain solutions. The ledger never forgets anything, it's an essential feature of blockchain technology. Especially when Blockchain is used to represent real contracts and their data, immutability and permanent availability are essential requirements especially from a legal and regulatory point of view.

2.2.2.5 *Network Connectivity*

Describe how the integrability of physical devices relates to a blockchain solution. Due to the importance of data sharing, the value of that data will increase over the next years, there is a significant need for solutions to trustfully exchange data and value directly between devices. Describe how it is possible to integrate the smallest possible devices in a way which is trustful and safe against attacks (like the man in the middle attack).

2.2.2.6 *Data Security & Privacy*

Describe how data security and privacy requirements impact design considerations for a blockchain implementation. This may impact the selection of a private or public blockchain. Considerations include:

- Will the system be deployed in a government or enterprise environment?
- What types of data will be transmitted?
  - Health information
  - National security
  - Personal Identification Information (PII)
  - Financial information
- Statutory or regulatory requirements such as:
  - GDPR
  - AML/KYC

- HIPAA

2.2.2.7 Data Decentralization

Describe how the decentralization of data will benefit or impede the efficient processing of data. Decentralizing data has benefits and liabilities. It has an inverted relationship with speed and scale. However, it also reduces the risk of fraud or loss. Describe how these factors conflict with each other.

2.2.2.8 Data Immutability

Describe why defining the level of confidence in the immutability of records is important. Explain how a 51% attack could be carried out. Also explain that the larger the network and the higher the threshold, the less likely it would be for data to be altered. Describe the different types of consensus algorithms and their susceptibility to data alteration.

2.2.2.9 Blockchain Governance

Explain how all blockchain systems require a governance model. The governance model must be defined. How will decisions be made with respect to changes to protocols, functions and data. This discussion should include how centralized decision-making requires the trust of the central authority (not blockchain). The decentralized decision-making model still needs to account for decision making. This will impact how hard-forks and soft-forks will be handled.

2.2.3 Design

2.2.3.1 Distributed vs Decentralized

Compare and contrast the difference between a distributed system and a decentralized system.

2.2.3.2 Network Considerations

Describe the network considerations relative to:

- Nodes – Include the type, functions, and relevance of nodes. These include:
  - Founding node (e.g., system/network admin, smart contract administration)
  - Types of communications among nodes (e.g, transactions vs messages vs alerts)
- On Chain vs Off Chain

- Use of channels (like Lightning Network) from both a capacity and security standpoint
- Describe the difference between hard-forks and soft-forks.

2.2.3.3 Permission Arrangements:

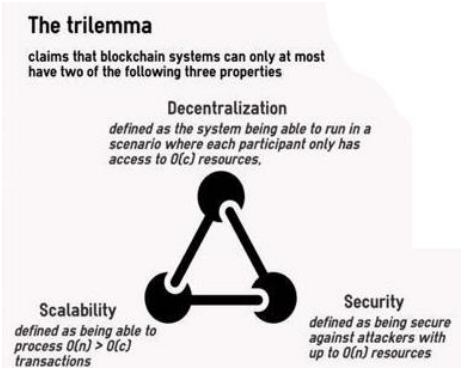
Discuss the various methods and models to permissioning blockchain.

Public	Public blockchains use consensus using a method that is not controlled by any party but is instead collaboratively agreed on by all actors in the blockchain.
Public Permissioned (Hybrid)	A consortium blockchain is a blockchain where the consensus process is controlled by a pre-selected set of nodes; for example, one might imagine a consortium of 15 financial institutions, each of which operates a node and of which 10 must sign every block in order for the block to be valid. The right to read the blockchain may be public, or restricted to the participants. There are also hybrid routes such as the root hashes of the blocks being public together with an API that allows members of the public to make a limited number of queries and get back cryptographic proofs of some parts of the blockchain state. These blockchains may be considered "partially decentralized".
Permissioned (Private)	A fully private blockchain is a blockchain where administrators assign roles to users who may have write permissions. Read permissions may be public or restricted to an arbitrary extent.

2.2.3.4 Distributed Database Trade Offs

Discuss the conflicts in design parameters between decentralization, scalability & security.

The CAP theorem states that it is impossible for a distributed database to simultaneously provide more than two out of the following three guarantees.



- **CONSISTENCY** – All clients see current data regardless of update/delete
- **AVAILABILITY** – The system continues to operate even with node failures
- **PARTITION TOLERANCE** – The system continues to operate despite network failures

2.2.3.5 Protocol: The set of rules that govern the network

Blockchain protocols usually include rules about consensus, transaction validation, and network participation. A protocol is used to define the architecture.

- Selecting the correct protocol is extremely important.
- How protocols are established, used, and managed.
- Other attributes that may impact protocol selection
  - Flexibility with membership
  - Compute equity
  - Shared business interests

- Select several protocol examples from the GBA publication library at www.gbaglobal.org/resources/categories/protocols

2.2.3.6 Consensus Mechanisms[1]

Consensus algorithms enable network participants to agree on the contents of a blockchain in a distributed and trust-less manner. The consensus algorithm plays a crucial role in maintaining the safety and efficiency of blockchain. Using the right algorithm may bring a significant increase to the performance of blockchain application.

Each consensus algorithm has its own application scenario. There is no absolute good or bad. The choice of which consensus to use for

[1] www.tokens-economy.com/downloads

implementing the blockchain depends on the type of network and data. For a transaction to be valid on most cryptocurrency networks, the transaction needs to collect a certain number of confirmations (often equals to an inclusion in a block of a blockchain) from the network.

Explain that consensus mechanisms are designed to mitigate erroneous or malicious activity.

- Denial of Service: overloading nodes with lots of transactions.
- 51% Attack: controlling more than 50% of nodes, can create fork longer than the main chain.
- Sybil attacks: when one node tries to represent multiple identities.
- Cryptographic attacks that break the underlying cryptography (Quantum).

Describe the various consensus mechanisms

- **Proof of Work (PoW)** - Each participate on the network can participate in the block generation. In order to confirm the transaction and enter a block into the Blockchain, a miner has to provide an answer, or proof, to a specific computational challenge.
- **Proof of Stake (PoS)** - Stakeholders are those having coins or smart contracts on the Blockchain. Only they can participate. Those with high stakes are chosen to validate new blocks
- **Byzantine Fault Tolerance** – A characteristic which defines the system that tolerates the class of failures that belong to the Byzantine Generals Problem and work as long as the number of traders does not exceed 1/3 of the generals.
- **DAG** - In order to send a new transaction, you need to validate two previous transactions that you received. The two-for-one, pay it forward strengthen the validity of transactions that are added to the tangle.
- **Proof of Capacity/Space (PoC/S)** – Proof of space, also called proof of capacity is a means of showing that someone has a legitimate interest in the service by allocating a non-trivial amount of memory or disk space to solve a challenge.
- **Proof of Burn (PoB)** – Participants show proof that they burned something (coin/time). For example, sending a coin to a verified un-spendable address.
- **Hybrid Models** - Most of the time a combination of existing consensus algorithms are used.
- Others include:
    - Chain-based Proof of Stake (includes LPoS, Proof of Importance)

- PBFT and BFT-based Proof of Stake (includes DPoS, Ouroboros, Byteball, and PBFT)
- Trusted Computing Algorithms (e.g. PoET)

2.2.3.7 Blockchain Platforms

Describe at least five major blockchain development platforms.

Summary of Features of top 5 Blockchain Platforms for Enterprises

	Ethereum	Hyperledger Fabric	R3 Corda	Ripple	Quorum
Industry-focus	Cross-industry	Cross-industry	Financial Services	Financial Services	Cross-industry
Governance	Ethereum developers	Linux Foundation	R3 Consortium	Ripple Labs	Ethereum developers & JP Morgan Chase
Ledger type	Permissionless	Permissioned	Permissioned	Permissioned	Permissioned
Cryptocurrency	Ether (ETH)	None	None	Ripple (XRP)	None
% providers with experience[1]	93%	93%	60%	33%	27%
% share of engagements[2]	52%	12%	13%	4%	10%
Coin Market Cap[3]	$91.5 B (18%)	Not applicable	Not Applicable	$43.9 B (9%)	Not Applicable
Consensus algorithm	Proof of Work (PoW)	Pluggable framework	Pluggable framework	Probabilistic voting	Majority voting
Smart contract functionality	Yes	Yes	Yes	No	Yes

1. *Based on responses from 15 leading blockchain service providers*
2. *Based on a random sample of set of 50 enterprise blockchain engagements across multiple industries*
3. *Coinmarketcap.com as of Feb 20, 2018, 6:20 PM UTC*

Source: HfS Research, 2018

HfS

2.2.3.7.1 Bitcoin

- **Features** – Very secure, tested, reliable, supports scripting for blockchain applications.
- **Challenges** – Not scalable, high energy costs, high transaction fees
- **Governance** – Consensus voting protocols

2.2.3.7.2 Ethereum

- **Features** - one of the most popular and mature blockchain platforms available today. Known for its robust smart contracting functionality and flexibility, it is used widely across multiple industry use-cases. It has the largest number of use-cases available today (50%+ in our sample set). It has developed a large online support community as well has frequent product updates and enhancements.
- **Challenges** – Ethereum is a permissionless (or public) platform that is designed for mass consumption versus restricted access (typical requirement for privacy requirements in enterprise use-cases). It is also PoW (proof-of-work) based which is not the fastest (resulting in potential latency issues) and is an energy-sucker. Though it might change its consensus algorithm to the fast PoS (proof-of-stake) in future versions.
- **Governance** - The Ethereum Enterprise Alliance (EEA), a non-profit organization is now over 250+ members strong and connects Fortune 500 enterprises, startups, academics, and technology vendors with Ethereum subject matter experts.

2.2.3.7.3 Quorum

Quorum™ is an enterprise-focused version of Ethereum. It is ideal for any application requiring high speed and high throughput processing of private transactions within a permissioned group of known participants. Quorum addresses specific challenges to blockchain technology adoption within the financial industry, and beyond.

For more information, see:
https://www.youtube.com/watch?v=lwgOwEKW2z0

- **Features** – Same capabilities as Ethereum but much fast faster. Designed for use of smart contracts for financial transactions.
- **Challenges** – Not yet identified.
- **Governance** – The technology was developed and is managed by J.P. Morgan Chase.

2.2.3.7.4 Hyperledger Fabric

Hyperledger is not a blockchain. It is not a company or organization. Hyperledger is a project managed by the Linux foundation. There are several projects in the Hyperledger family including: Iroha, Sawtooth, **Fabric**, Indy, and Burrow. Each project is sponsored by different companies. For example, IBM sponsors Hyperledger Fabric (one of the most popular in

the large enterprises). For more information about Hyperledger see https://www.youtube.com/watch?v=k4KKrQOV6SE

- **Features** - It is an attractive blockchain framework for enterprise solutions, given its modular architecture, as it allows plug-and-play components around consensus and membership services. It recently announced the release of Hyperledger Fabric 1.0 that claims to be production-ready for enterprises.
- **Challenges** – Requires trusted authorities to administer the network
- **Governance** – Hyperledger, hosted by Linux Foundation and launched in 2016, is an open-source collaborative effort to advance cross-industry blockchain technologies. One of its key goals is to create enterprise-grade distributed ledger frameworks and codebases. Hyperledger boasts 185+ collaborating enterprises across finance, banking, Internet of Things, supply chain, manufacturing and technology. Hyperledger Fabric is one of the 8 ongoing Hyperledger projects that was initially contributed by IBM and Digital Asset.

2.2.3.7.5 Corda

Share information with students about Corda. For more information see: https://www.youtube.com/watch?v=tuNopsfWQwA

- **Features** – Data is only shared on a need to know basis. There is no global broadcast of transactions. All communications between the nodes are direct. Nodes are arranged in an authenticated peer-to-peer network. Also, Corda is not restricted to a particular consensus algorithm. It employs different algorithms for different scenarios. Another feature is that even though it is a semi-private network, it allows the creation of an entirely anonymous Corda network. And, for each transaction, a fresh key is generated for each party (key randomization) which prevents an observer from identifying which parties were involved in a given transaction. Lastly, Corda does not have per transaction network fees, which is a huge source of complexity in the other systems.
- Challenges – None
- **Governance** – The R3 Foundation of over 300 firms and is governed by board members, elected from the community of users.

2.2.3.7.6 RippleNet

Describe the RippleNet blockchain platform as a network of institutional payment-providers such as banks and money services businesses that use

solutions developed by Ripple to provide a frictionless experience to send money globally.

For more information see https://www.inverse.com/article/39864-how-ripple-works

- **Features** – Fast, cross border payments with lower fees.
- **Challenges** – Explain the difference between RippleNet and XRP (the token). There is often times confusion between the token and then network.
- **Governance** - Ripple Labs, Inc. is an American technology company which develops the Ripple payment protocol and exchange network. Originally named Opencoin and renamed Ripple Labs in 2015, the company was founded in 2012 and is based in San Francisco, California.

2.2.3.8 Alternative Platforms

Describe alternative distributed architectures including DAGs

- Hashgraph (IOTA). See: https://www.youtube.com/watch?v=lRRo__pJGWs
- Holochains. See: https://www.youtube.com/watch?v=hyCtYrHJebs

2.2.4 Development

Developing a blockchain system can be done in two ways. The two options are using a skilled developer or using a blockchain development tool. It is similar to having a website developer or using a website builder wizard provided by most website hosting businesses.

2.2.4.1 Blockchain Development Platforms

Explain that development platforms (Blockchain as a Service) allows non-developers to use drag and drop user-friendly interfaces to create blockchain systems. Use the development platforms listed at www.gbaglobal.org/applicationsproducts/categories/platforms as examples.

2.2.4.2 Blockchain Development Languages & Tools

Describe tools specifically designed to build blockchains include Solidity and Truffle. Also describe how developing the application interfaces requires the skills and capabilities to program using the following technical languages: GO, Javascript, C/C#/C++, Rust, Python, and Perl.

2.2.5 Testing

Explain the importance of understanding the link between requirements and testing. Also explain that testing a blockchain application requires a thorough and comprehensive testing phase (even more than traditional development.

2.2.5.1 Types of Blockchain Testing

Describe the importance of the following types of testing for blockchain applications:

- **Functional Testing** – Ensures that all functions execute as expected. It is important to consider use cases and scenarios to test the boundaries of the system.
- **Unit Testing** – It is important to test each physical and functional component including access management, error management, consensus, transaction/block activity, message activity, and data retention, and Intra- and inter-node communications.
- **Integration Testing** – Many blockchain systems are heavily integrated with off-chain repositories, applications and databases. Testing the components individually as well as end-to-end of systems identifies bugs before deployment. Use of process flows are very helpful with system integration testing.
- **Security Testing** – It is critical for security to be defined in the testing plan and built into the system (up front). Fully considering the security risks in advance will aid the engineers. The GBA Cybersecurity Working Group has published a report that describes how blockchain technologies can be assessed using the governments risk management framework. You can read the report at: https://www.gbaglobal.org/resources/listing/assessment-and-authorization-of-blockchain-systems. This report provides guidance for a blockchain based solution to receive the Authority to Operate (ATO) by meeting the (US) Federal Information Security Management Act (FISMA) and National Institute of Standards and Technology (NIST) requirements.
- **Performance Testing** – Blockchain solutions are susceptible to performance issues. Estimates of transaction volumes are extremely important. Network latency and consensus algorithms have significant impact on overall system performance. Also, internal algorithms that adjust difficulty and thresholds must be tuned to achieve the overall desired balance between performance and
- **Smart Contract Auditing** – One of the major attributes of blockchain applications is the immutability of transactions. Consequently, audits of

smart contracts is extremely important. Common smart contract errors include:

- stack problems, compilation, and reentrance mistakes.
- Smart contract host platform's known errors and security flaws
- Break testing the smart contract (this includes simulating attacks on the contract)

2.2.5.2 Blockchain Testing Tools

Describe some of the tools that can be used to test blockchain systems. Examples include:

Truffle

Ganache (Formally TestRPC) - is a fast and customizable ethereum blockchain emulator. It allows making calls to the blockchain without the overheads of running an actual Ethereum node.

2.2.5.3 Blockchain Testing Challenges

Describes some of the challenges with blockchain testing. They include:

- Innovation of blockchain technology is moving at a very fast pace
- Blockchain technology is quickly moving into the mainstream
- Testing expertise for blockchain systems is rare and difficult to acquire
- Lack of bet practices, models, tools for blockchain testing
- Lack of standardization for blockchain testing

2.2.6 Deployment

Describe how blockchain solutions require post development support and management. This includes designing, establishing and maintaining a governance model to make decisions regarding changes to the protocol (may require a hard – fork). How will changes be made to the protocol and how will those changes be recorded, reviewed, analyzed, dispositioned, communicated and deployed. Also, consider how expenses, legal & regulated issues will be managed once the system is operational.

2.3 Blockchain Healthcare Specialist Course

The purpose of this course is to provide students with a well-rounded foundation of the intersection of healthcare with blockchain technology to aid them in the decision-making process. It supports the decisions including:

- Do I need a blockchain?
- What are the factors that I should consider when implementing a blockchain?

2.3.1 Healthcare Megatrends & Introduction to Blockchain

Describe some of major trends in healthcare and how they relate to blockchain. These include:

- Rising costs
- Regulatory challenges
- Medicinal & Technological Challenges
- Training & Education Challenges
- Ethical Challenges
- Clinical Trials
- Data Management/Access Control/Consent Management
- Drug Supply and Anti-Counterfeiting
- Fraud, Waste & Abuse
- Value-Based Healthcare Systems
- Increased emphasis on prevention

2.3.2 Clinical Trials Management

2.3.2.1 Data Availability

Explain that Electronic Health Records (EHRs) were supposed to create a longitudinal ledger to ensure that healthcare events are tracked in their correct chronological order and span a patient's continuum of diagnosis and treatment. However, EHRs are based on proprietary software from different suppliers that do not share their data. That means that while lots of data is being collected, it is not being readily shared and available for research.

Describe how the collection of data via the use of wearables, genomics, monitors and other data collection methods creates a wealth of data that has great value for research and clinical trials. Explain how this type of data may be collected via personal health records (PHRs). Once individuals start collecting their own health data, they can opt to anonymize that information and sell it to researchers, vastly expanding the pool of information available for clinical studies.

Explain that since no data is as sensitive as a medical record, being able to assure its security and immutability through blockchain encryption represents a unique opportunity to "repatriate" and "monetize" that record for the patient[2] and make it available for research and clinical trials.

[2] Statement of Dr. Eric Hoskins, chair of Canada's Federal Advisory Council on the Implementation of National Pharmacare.

2.3.2.2 Data Marketplaces

Explain that there is already a multi-billion-dollar industry that collects patient information, strips it of basic personal identifiers such as name, address and Social Security Number, and then sells it off to researchers, drug developers, marketers and others. Medical informatics companies such as Iqvia (IMS Health), Optum, and Symphony Health collect the profits of selling the healthcare data while the patients from whom it's collected have no control over how it's used. Nor do they get any compensation for it.

Describe how solution providers are establishing blockchain marketplaces that are enabling patients to collect, and release health information in a better distribution model that increases the amount and integrity of research data.

2.3.2.3 Data Integrity

Explain how blockchain could improve the integrity of the results. Discuss how blockchain could:

- Reduce or eliminate outcome switching, a practice employed by some companies have altered the result of drug tests to influence the outcome
- Improve specimen tracking

2.3.3 Public Health

Explain how blockchain technology can be combined with AI to collect public health data from a multitude of data sources including hospitals, clinics, airports, ports, schools and mass transit stations to collect health data to quickly identify, track and address public health concerns.

2.3.4 Data Management/Access/Control + Consent Management

Discuss how medicine is increasingly becoming a data-driven science. Patient datasets are expanding, thanks to genomic data and patient- generated data. The convergence of medical data about patients generated by healthcare providers along with a vast amount of non- medical, lifestyle related data, necessitates methods to manage and safeguard data. Describe how the following topics are related to blockchain technology:

- **Access:** Access to personal health data for patient is not straightforward, not timely, and often patients are not offered with option for easily share their data with other individuals

- **Security**: There is a growing concern regarding data security, given the increase of identity theft and data breaches. It is estimated that between 2009 and 2017, more than 176 million patient records were exposed in data breaches. The perpetrators stole credit card and banking information, as well as health and genomic testing records.
- **Data Value**: Hospitals and other healthcare providers are not able to extract maximum value from their data, resulting in the processing by third party tools. This enables improved diagnosis and therapies.
- **Ownership**: How will the collection of data to mIoT, smartphone, and Personal Data Account, a new era of healthcare democratization will start

2.3.4.1 The General Data Protection Regulation (GDPR)

- **Data access**: "A data subject should have the right of access to personal data which have been collected concerning him or her"
- **Right to data portability**: receive personal data in a structured, commonly used, machine-readable and interoperable format"
- **Consent:**
  - Freely given, informed, and specific
  - Easily readable, and in plain language
  - Data controller will have to demonstrate consent

2.3.4.2 A.I.'s Bias Problem

- AI algorithms are known to be extremely data hungry, and their effectiveness depends on quality and quantity of data used for their training
- Also due to the fact that data for training are in siloed database, AI algorithms have already showed to be biased, and not able to provide proper answer to questions in regard to specific diseases/populations
- In order to overcome this issue, open distributed databases could be a solution, provided that they ensure:
- Data integrity
  - Interoperability
  - Lawful data access, security and privacy

2.3.4.3 Why Blockchain is Relevant for Health Data Management

Discuss issues associated with centralized or siloed healthcare data management including:

- Barriers preventing a patient's access to their own medical data
- Centralized systems are vulnerable to theft and data breaches

- Patients receiving incomplete, duplicate or incompatible treatments

Discuss how blockchain may provide solutions including:

- Enabling patient-centric healthcare (also through personal data account)
- Enabling direct control of data by patients, overcoming the current
- Paternalistic approach on data management
  - Patients can be able to decide who can access to data, for what purpose, and also get compensation
- Facilitating health data exchange relying on peer-to-peer distributed architectures
- Creating new economy and market around patient data

- Improving economic incentive schemes and provide individuals with additional motivations for engaging with their health.

2.3.5 Drugs Supply Chain & Anti-Counterfeiting

Describe that according to some studies that there are hundreds of billions of dollars of fraud in medications in the pharmaceutics supply chain. Some studies indicate that one hundred thousand people die each year taking poison – drugs that were not what they thought were taking. Also explain that 30% to 40% of the costs of administration of the pharmaceutical industry by U.S. government agencies is considered waste because of inefficiencies from a disparate tracking system. Explain that a single, standardized network for regulators to oversee drug manufacturing and distribution could reduce that waste,

"Blockchain's cryptography can provide the underlying security so patients and doctors can share data. In terms of single source of truth, it's very important for everything from supply chains to doctors and patients being able to communicate"

Also discuss the following related topics:

- Explain how audits of the pharmaceutical supply chain could be impacted by blockchain
- Blockchain could be used to track opioids and address prescription abuse

2.3.5.1 Overview of the Supply Chain Process and Specific Inefficiencies with Each Step

- Discuss the supply chain from the medical supply manufacturer to the patient including the manufacturer, distributor, vendor, pharmacy, nurse and patient.

- Identify the entry points for substandard and falsified medicines?
- Provide current statistics on counterfeit drugs and how they enter the system.

2.3.5.2 Blockchain Technology & Supply Chain Integration

Discuss the points of potential integration of blockchain technology with existing systems. The discussion should include:

- How can smart contracts authenticate steps in the process?
- How can scanners and sensors be integrated into blockchain based systems?
- How can mobile and desktop applications augment blockchain based systems.

Describe how technology can benefit all interested parties. Include:

- Pharmaceutical companies, FDA, pharmacy, etc. (all steps in the process)
- Detailed example walkthrough

Identify current examples of real-world implementation of blockchain use in the healthcare field. Use examples from GBA Healthcare members identified here:

- www.gbaglobal.org/resources/categories/healthcare
- www.gbaglobal.org/category/health-care

2.3.5.3 Future Additions

Discuss how artificial intelligence, Internet of Things (IoT) and Big Data Analytics could be integrated with blockchain technology to solve healthcare supply chain challenges.

2.3.5.4 Barriers to Implementation

Discuss what some barriers to using blockchain in healthcare supply chains might be and ways to overcome them. Include:

- Industry inertia
- Cost of implementation
- Education/Making adoption easy
- Regulatory uncertainty

2.3.6 Insurances (Claims Management/Frauds Reduction)

Explain how blockchain gives payers the ability to keep a record of transactions, linked to EHRs and used to time-consuming tasks, such as claims adjudication and prior authorization. The impact of this technology could

result in enormous savings in administrative costs and speed reimbursements to all parties. It could also substantially reduce fraud, waste and abuse.

2.3.7 Improving Administrative Processes

Explain how blockchain can make the current status and historical records of assets (monetary and non-monetary) both available and secure. An example of some of these processes that could benefit from blockchain include:

- Audits
- Price transparency and real-time market-based price adjustments
- Processing legal disclosures and medical releases
- Professional credentialing

2.3.8 Value-Based Healthcare System

2.3.8.1 Value Based Care Definition

Explain the healthcare trend of transitioning from Fee for Service (FFS) to Value Based Care. Describe how reimbursement that tie payments for healthcare delivery of services to the quality of care are provided via defined metrics and rewards providers of care for both efficiency and effectiveness.

Communicate the quote:

> *"Patient **value** is **defined** as patient-relevant outcomes, divided by the costs per patient across the full cycle of care **in** order to achieve these outcomes. **Value-Based Healthcare** focuses on maximizing the **value** of care for patients and reducing the cost of **healthcare"**.*[3]

2.3.8.2 Value Chain Stakeholders

Describe how the following stakeholders can be involved in the collection, analysis, reporting and improvement of value measures.

- Consumers/patients
- Providers of care
- Hospitals/clinics/surgical centers/nursing homes
- Employers and their health plans (payers)
- Health claims processing companies
- Preferred provider organizations (contract managers)
- Federal or state agencies monitoring quality
- Pharmacies, laboratories, medical suppliers,

[3] Quote by *Michael Porter, Apr 2, 2018*

- IT companies
- Banks/lending agencies

2.3.8.3 *Types of Value Based Reimbursement by Payment Model*

Discuss the value-based reimbursement models and discuss how they can be implemented with a blockchain based solutions.

- FFS with link to quality and value:
  - Pay for reporting (bonus for reporting only)
  - Pay for performance (bonus for quality performance)
- Alternative Payment Models (APMs) built on FFS architecture
- Shared savings:
  - upside risk only
  - with downside risk
- Full risk (global or partial capitation)
- Population based payment models:
  - Bundled payment/Episodes of care
  - Patient Centered Medical Homes
  - Clinically Integrated Networks or Electronically Integrated Networks (CINs/EINs)
- Provider Sponsored Health plans
  - Employee Only
  - Employee + Community

2.3.8.4 *Alternative Payment Models by Payer Type*

Discuss the alternative payment models and discuss how they can be implemented with a blockchain based solutions.

- Government Only (Medicare, Medicaid)
- Managed Medicare/Managed Medicaid
- Administrative Services Only (ASO)
- Independent Third-Party Administrators (TPA)
- Commercial Only (Fully Insured)
- Employer Owned TPA (Self-insured)

2.3.8.5 *Value-Based Healthcare Challenges*

Discuss how blockchain technology can address some of these challenges in implementing value-based healthcare:

- Identity Verification, Authentication and Authorization
- Value Transaction Exchange
- Contracting/Pricing
- Auditing

- Fraud Prevention (KYC - Know Your Customer)
- Revenue cycle management optimization
- Payments
- Quality Metrics Monitoring
- Consumer access/transparency/satisfaction

2.3.8.6 Major Blockchain Adoption Barriers in In Value-Based Care

Discuss the barriers to blockchain adoption to ways to overcome these barriers. The discussion should include:

- Regulatory
- High cost
- Misinformation
- Lack of professional expertise
- Lack of infrastructure

2.3.8.7 Impact of Blockchain Technology In Value Based Care-Cost Verification

Discuss the cost-drives for verification. Discuss costs associated with using *per groups and reviews.*

Describe the attributes and characteristics that would significantly reduce cost of verification. Include:

- *Agreement between all parties*
- *Non-excludable information*
- *Smart contracts*
- *Full automation*

2.3.8.8 Impact of Blockchain Technology in Value Based Care-Reduced Cost of Networking

Discuss how the cost of networking using *per groups could be reduced. Discuss the attributes and c*haracteristics that would reduce cost of networking. Include a discussion of:

- *National database for all CMS Value Behavior (VB) contracts*
- *National database for all commercial VB contracts*
- *Smart contract system that enables easy customization of VB contracts between payor and provider*

2.3.8.9 *Impact of Blockchain Technology in Value Based Care-Decentralized Networks*

Describe how a decentralized network (*per group) can support b*enefits of decentralized networks for value-based contracts. This includes:

- *Reduction of Central Control*
- *Higher efficiency*
- *Faster turnaround time*
- *Higher security*
- *Price Transparency*
- *Faster payments*
- *Overall less cost to society*
- *Optimized QA/QI process*

2.3.8.10 *Impact of Blockchain Technology in Value Based Care-Digital Privacy*

Discuss how digital privacy can be established and maintained using a *per group.* Describe the attributes and characteristics of a Blockchain-technology based VBC system that would optimize digital privacy. The discussion should include:

- *Selection of private vs public blockchain for various elements within value-based care contracting*
- *Enhanced auditability*
- *Right to erasure*
- *Tokenization*

2.3.9 New Business Models in Healthcare and the Role of Tokenization

Explain how healthcare networks are developing tokens that are used by individuals to receive care, review patient data, or access IT systems. Tokens can be generated based on the person's affiliation with the organization and can be linked to the person through physical characteristics. That would mean that there would be no passwords for employees, patients, clinicians and others to generate, remember, and protect.

These tokens could be used to build trust frameworks for any size healthcare organizations to secure enterprises and protect patients.

Tokens could be used by patients, physicians, nurses, clinicians, staff, contractors, researchers, vendors, partners, etc.

The benefits of a token-based trust framework include:

- Integrity of information across disparate systems including enterprise resource planning (ERP) and electronic health record (EHR) software,

to identity access management (IAM) programs and practice management software gain integrity from anonymous SYM Tokens that cannot be misused.

- Mitigation and effective responses to data breaches. Token-based trust frameworks can improve the preparation, prevention, and responds to data breaches for healthcare organizations and any employer that holds personal information subject to HIPAA standards.
- Improved patient experiences - A token-based systems ensures that patients only have one unique identifier- and therefore medical record- within a single healthcare organization and across the industry, protecting patient safety and privacy. Patients are consistently, accurately, and conveniently confirmed for medical care and when accessing patient portals, improving the patient experience and enhancing patient engagement.
- Integrated and accurate compliance programs – Tokens could enable an organization to better control, monitor and report activity performed by accounts based on a known, tokenized entities.
- Process integrity – Token based trust framework use smart contracts to ensure that people, equipment and events operate within a rules-based framework and minimize accidents, oversights and errors.

Explain that all of the benefits of blockchain can be included in a token-based trust-framework.

2.3.10 From Acute Care to Prevention – The Role of Blockchain in 4Ps Medicine

Describe the difference between big data and small data (the data generated that provide health information about an individual's). They describe the micro-changes that reveal subtle changes in activities and status.

Describe how blockchain can be used to collect data from various sources to provide individuals with information that can be used to practice preventive care.

- Explore the many kinds and sources of small data for personal health
- Discuss how data can become available to individuals
- Discuss how open architectures like the internet can facilitate a rich marketplace of individualized, personal data for individuals.

2.3.11 Regulatory Such as HIPAA & GDPR

Describe the opportunities and challenges introduced by blockchain related to regulatory requirements like HIPPA and GDPR.

2.3.11.1 Health Insurance Portability and Accountability Act (HIPPA)

Discuss the requirements and how blockchain is related to each requirement:

- Title I: Health Care Access, Portability, and Renewability
- Title II: Preventing Health Care Fraud and Abuse; Administrative Simplification; Medical Liability Reform
- Title III: Tax-related health provisions governing medical savings accounts
- Title IV: Application and enforcement of group health insurance requirements
- Title V: Revenue offset governing tax deductions for employers

2.3.11.2 General Data Protection Regulation (GDPR)

Discuss the requirements and how blockchain is related to each requirement:

- Lawful, fair and transparent processing
- Limitation of purpose, data and storage
- Data subject rights
- Consent
- Personal data breaches
- Privacy by Design
- Data Protection Impact Assessment
- Data transfers
- Data Protection Officer
- Awareness and training

2.3.12 Technical Implementation & Challenges

Discuss some of the technical implementation challenges to developing and deploying a healthcare blockchain system. Include the following challenges:

- Currently fragmented healthcare systems
- Scalability
- Insufficient interfaces
- Lack of technical standards

2.3.13 Business Challenges

Discuss some of the business challenges to developing and deploying a healthcare blockchain system. Include the following challenges:

- Lack of general understanding of blockchain technology, capabilities and risks
- Inadequate trained resources to design and develop blockchain applications
- Uncertain regulatory environment

- Inadequate project management experience to plan, estimate and implement blockchain projects

2.3.14 Cultural Challenges

Discuss some of the cultural challenges to developing and deploying a healthcare blockchain system. Include the following challenges:

- Resistance to total transparency that could reveal errors and liabilities
- Fear, uncertainty and doubt about technology replacing jobs and positions
- Resistance to placing processes on a blockchain / smart-contract and devaluing the expertise of seasoned professional healthcare workers

2.4 Blockchain Legal Specialist Course

2.4.1 Introduction

2.4.1.1 Disclaimer

Please inform students that none of what follows is legal or tax advice—this is for educational purposes only. You should not rely on it and you should seek advice from a licensed legal adviser.

2.4.1.2 Learning Objectives

- Describe the learning objectives of the course. They are:
- Discuss the impact of blockchain technology on existing legal and regulatory frameworks
- Identify the legal considerations when developing and implementing a blockchain solution
- Provide tools and analytical framework to perform compliance and risk assessments
- Discuss legal and regulatory decisions related to blockchain and cryptocurrency

2.4.1.3 What Makes This Different

Describe why this technology impacts legal issues. Explain that these new forms of transactions and business processes have never been seen before. The concept of decentralized governance of a currency involving hundreds of billions of dollars in transactions without anyone in control is revolutionary. The idea that anyone could mint their own currency or create tokens that could be used globally and anonymously did not fit the existing legal and regulatory models. The technology also allows for self-executing

contracts that are immutable. It also impacts both privacy and transparency in new ways.

2.4.1.4 What is Now Possible

Explain that this new "capability" allows retail banks to execute cross-border payments in seconds, without central banks and at lower costs. It allows for monetary transactions to exist outside of banking systems used by governments to monitor and influence economic activity. It enables new business models and governance models.

2.4.1.5 What Does This Mean?

Explain that this technology may erode national sovereignty over their own currency, governments ability to control capital flight and potentially impacts every type of value transaction in society. It may erode governments ability to monitor, influence and control aspects of the economy. On the other hand, it may enable new tools to be used by government to monitor transactions and activities.

2.4.1.6 Is Our Current Legal & Regulatory Framework Adequate?

Ask the class their thoughts on our current laws, rules, and systems are adequate to manage this "transformational" technology? Discuss the impact it will have on virtually every aspect of our legal, regulatory and governance systems.

2.4.1.7 What Needs to Change?

Ask the class what aspects of the legal and regulatory framework needs to change. The discussion is intended to prime the pump and get students to thing about the content covered in this course.

2.4.2 Blockchain & Cryptocurrency

2.4.2.1 Beliefs, Values & Paradigms About Money, Cryptocurrency & Blockchain

Describe the difference between values and beliefs. Beliefs are opinions about what is real. Values are opinions about wat is important. The combination of these two make up our paradigms. Discuss these statements and identify if they are beliefs, values or paradigms:

- Banks are too big to fail
- Cryptocurrency is dangerous
- Cryptocurrency is money
    - God himself couldn't sink the Titanic
- Governments have sovereignty over money
- The US Dollar will always be the reserve currency

2.4.2.2 The Blending of Money, Speech & Technology

Explain that some countries have laws protecting free speech. However, they also have strict laws regulating financial transactions. However:

- Money can be in the form of cryptocurrency
- Cryptocurrency is code
- Code is language
- Language is speech

How does this impact the concept that money equals speech? And, how does this relate to the blending of money, speech and technology? How does this impact rights and protections?

2.4.3 Core Government Functions

2.4.3.1 Identity

Every government is responsible for establishing the identity of entities within its borders. Discuss how AML/KYC requirements are impacted by blockchain. Discuss how privacy coins like Monero, Z-Cash and Grin impacts the laws.

Explain the Protection of Personal Information Act (POPIA), and supra-national regulations, such as the General Data Protection Regulation (GDPR), which is effective from 25 May 2018.

2.4.3.2 Law Enforcement

Blockchain has both positive and negative impacts on many areas of consideration. Discuss how the use of privacy coins will make it difficult for law enforcement to identify criminals and deter criminal activity. Also discuss how the immutable and permanent nature of the blockchain may make it much easier for law enforcement officials to identify, track, apprehend and convince criminals.

2.4.3.3 Consume Protection

Discuss the role that the government plays in the areas of protection including transactions of investment, securities and utilities. Discuss the conflict between securing transactions and negatively impacting innovation. Discuss where the balance needs to be.

2.4.3.4 Economic Sovereignty – An Identity Crisis

Describe how blockchain and cryptocurrency enable anyone or any organization to establish their own economy. Explain that this includes individuals, companies, financial institutions, and open source communities like bitcoin. Discuss the link between economic and legal frameworks. The traditional framework is that the government regulates banks and banks monitor transactions. However, if cryptocurrency has widespread adoption, how will the legal framework need to be changed if there is an increase in digital assets that could be used as payment systems.

2.4.4 Blockchain Legal Considerations

2.4.4.1 Tokens

Describe how tokens traditionally have been physical and how it has been difficult to exchange poker chips in a casino for Chuck-e-Cheese tokens. However, the advent of digital tokens that are exchanged on electronic (decentralized) exchanges and interact with digital wallets that almost everyone will have on their phones creates an entirely new financial system. Also consider how open source AI and other bots can analyze the values of digital assets and exchange them for higher values. For example, if the commercial value of airline miles appreciates relative to the commercial value of a hotel points, your digital wallet could rebalance your portfolio without any human interaction. Use examples like how the HTC's blockchain phone, the EXODUS 1s, now allows users to directly swap between some cryptocurrencies within its native wallet. The addition means users can swap between ERC-20 tokens directly in Zion Vault, removing the need to first move tokens to third-party cryptocurrency exchanges. Discuss how banking laws written for government licensed financial institutions may need to change when considering how digital tokens will be exchanged.

2.4.4.2 Currency

Explain that legal tender is any official medium of payment recognized by law that can be used to extinguish a public or private debt or meet a financial obligation. The national currency is legal tender in practically every country. A creditor is obligated to accept legal tender toward repayment of a debt. Legal tender can only be issued by the national body that is authorized to do so, such as the U.S. Treasury in the United States and the Royal Canadian Mint in Canada.

Explain that while some governments have banned any use of cryptocurrency, other governments are excepting cryptocurrency as tax payments. Ohio accepts tax payments in cryptocurrency. Explain how phone manufactures are incorporating bitcoin nodes into phones, and explain how mass retailers like Whole Foods and Starbucks are accepting Bitcoin will impact cryptocurrency adoption. So, while legal tender is required, the range of alternative payments is exploding. The State of Wyoming has granted cryptocurrency the same legal status as money which has a wide-ranging impact on contract and business law.

2.4.4.3 Privacy vs Transparency

Describe how blockchain technology in its purest form is radically transparent. Discuss how privacy regulations make blockchain architecture difficult to implement.

2.4.4.4 Governance

People have experienced evolved governance models from tribal chiefs to advanced political theories like democracies, republics and collectives. However, Blockchain introduces an entirely new governance model. Public blockchains like Bitcoin and Ethereum use a model called consensus. It includes two complementary and mutually exclusive principles. They are:

- Code is law
- Consensus rules

Describe the DAO Hack and the two competing principled arguments. Explain how a hacker or hackers diverted more than 3.6 million Ether by exploiting a feature in The DAO that allowed participants to double-spend by splitting The DAO multiple times before the balance was updated. The hacker said that they were just using a feature in the code (code is law) and that their actions did not violate any contract, terms or law. Others claim that it was not right (consensus rules) and a that a fork should be

instituted to render the Ether inaccessible. Discuss how these two principles interact in new governance models and what the potential implication of these principles are.

2.4.4.5 *Smart Contracts*

Explain that establishing and executing smart contracts can trigger a wide range of legal risks and issues. List several and cote examples. They could include:

- **Applicable law** — Consider the implications of related legislative instruments such as, the Consumer Protection Act (CPA), the National Credit Act (NCA) or the Copyright Act. Also remember to accommodate legislative amendments across various jurisdictions.
- **Audits** — Discuss if self-executing code can replace the legal requirement for audits?
- **Confidentiality** — Discuss the juxtaposition of confidentiality and transparency. How can they be balanced?
- **Contract language (writing or just code)** — Discuss how our legal system will need to change if smart contracts are generally adopted and have immutable contract terms. How will this impact judicial decisions?
- **Data protection** — Discuss who has the authority and capability to protect data on a blockchain? Who can be held responsible for data breaches?
- **Digital identity** — Can legal contracts be established between unknow entities? Smart contracts allow it. Historically, AML/KYC requirements have been assigned to banks and financial institutions. How is that likely that change? What are the legal ramifications with
- **Dispute resolution** — Since smart contracts are immutable, how will dispute resolution be addressed? Will it be internal or external to smart contracts?

○ **General principles of proper governance**	Describe the governance model of an organization (with leaders, structure, and delegations of authority). Compare it to how governance would work with a smart contract.
○ **Jurisdiction**	Discuss how jurisdictional issues would be determined in a smart-contract.
○ **Legal interfaces**	Smart contracts must interface with existing legal structures in order to be valid and how they may conflict with existing legal and judicial requirements.
○ **Liability**	If the contract has errors in the code and it does not execute the intention of the parties, or if the oracle makes a mistake or error, how will liability be addressed?
○ **Non-compete agreements**	Consider how competitors could access the same smart contract and how would this situation be disclosed, addressed and mitigated.
○ **Non-disclosures**	The Smart contract may make certain information to the public or other DAO members. How would the disclosure of information be managed?
○ **Privacy**	Do the parties to the contract have a right to privacy? Do they have the right to privacy from each other or with each other?

2.4.4.6 Decentralized Autonomous Organizations (DAOs)

Another area of legal uncertainty is the establishment, sustainment and disposal of a DAO.

2.4.4.6.1 Who Owners a DAO?

Discuss the legal issues with regards to the ownership of a DAO. The discussions should include:

- Ownership defined by:
  - Use
  - Extract economic value
  - Dispose of it
- Two principles. They are:
  - Owned by many
  - Owned by none (Autonomous)

2.4.4.6.2 Are DAOs legal persons?

Discuss the issue of personhood and if a DAO may be considered a person from a legal perspective.

2.4.4.6.3 What Jurisdiction are they in?

Discuss how jurisdictional issues would impact a DAO and how would jurisdiction be established.

2.4.5 Legal & Regulatory Frameworks

Legal systems are decomposed into levels of government and scope. The paragraphs below describe both of those topics.

2.4.5.1 Levels of Government

Every level of government imposes legal expectations. The able below describes some of the topics and issues related to levels of government and blockchain/cryptocurrency.

2.4.5.1.1 International

European Union	Legal	• No specific legislation regarding cryptocurrency • Exempt from VAT/GST[4] when exchanging fiat and crypto • VAT/GST apply in transactions using cryptocurrency

[4] Value Added Tax (VAT) / Goods & Services Tax (GST)

		• No member state is able to issue their own cryptocurrency.
European Central Bank	N/A	Traditional financial sector regulation is not applicable to bitcoin because it does not involve traditional financial actors
European Parliament	Legal	Require cryptocurrency exchanges and cryptocurrency wallets to identify suspicious activity
United Nations	Legal	UN launching their own cryptocurrency. Discuss the impact of the United Nations competing issuing their own currency and how that currency will compete with national or local currencies.

2.4.5.1.2 National

Explain how cryptocurrency is not uniformly legal or illegal across nations. Each nation has very different treatment of the legality of Cryptocurrency. Discuss the legal issues in the country where the class is being delivered and cite several other examples of other countries from sources such as:

- US Library of Congress
- Wikipedia

Also explain while cryptocurrencies may be legal, there are countries that are friendly to cryptocurrencies and others that are not. Explain the factors and status of of the degree of receptiveness. Use examples from sources such as:

- 99 Bitcoins

Describe national efforts to promote and inhibit blockchain and cryptocurrency adoption. Cite examples relative to the audience. Here are some examples.

- In Favor

Describe the efforts being made by the US House Congressional Blockchain Caucus

- Against
  - US Representative Sherman called for a ban on Cryptocurrencies because he says it threatens to diminish American Power. His comments were tweeted by Coin Center.
  - The World Bank Chief Economist, Joseph Stiglitz, predicted that Bitcoin will be stifled through intense regulations as the market develops.
  - China is one example of this type of anti-crypto behavior affecting the market. Chinese officials have been so effective at slowing their crypto sector that their central bank recently publicly boasted about killing almost all Bitcoin trade in the country. While China's Bitcoin ban seems excessive, they are not alone in attempting to squash the emerging crypto market via anti-Bitcoin law. In fact, many countries have banned Bitcoin in the past.

2.4.5.1.3 State/Provincial

Describe the scope of responsibility typically allocated to the state/provincial level of laws. Explain that every state has jurisdiction over some aspects of society. However, the national governments have jurisdiction over other aspects. For example, in the US states have jurisdiction over:

- Banking
- Business licenses
- Insurance
- Identity
- Vital Records
- Permitting
- Property management

The current legal & regulatory framework for each state needs to address topics including the receipt, storage, reporting and disposal of digital assets.

Each state has different laws concerning cryptocurrencies and blockchain. For example, Wyoming has extended property rights to digital currency (Individuals can own it directly, not just through a third-party). Wyoming also passed legislation officially recognizing cryptocurrency as money.

Describe the challenge that blockchain and cryptocurrency solutions provides face when being required to comply with a patchwork of various state/provincial legal requirements. Use examples from resources like the National Conference of State Legislators.

2.4.5.1.4 Local (Smart Cities)

Describe how the development of Smart Cities may impact legal and regulatory issues. These include:

- Data collection
- Governance models (who can make decisions about price, availability, capacity, and other attributes)
- Privacy and data sharing
  - Businesses
  - City management
  - Data anonymization
  - Law enforcement
  - Political parties
  - Public
  - Public health
- Liability

2.5 Blockchain Financial Specialist Course

This course will address the impact of blockchain technology on government financial systems. It includes the impact of blockchain and cryptocurrency on financial institutions and government financial regulators and economic governance.

2.5.1 Redefining Money

Discuss the properties and/or functions of money. Also briefly address the timeline of money (briefly). Discuss how money is valued. Where does the value come from? How and why do people put their trust or faith into any currency.

2.5.2 Money, Inflation & Debt

Discuss how fractional reserve lending and other mechanism to impact the supply of money impact interest rates, inflation and economic activity. Also, discuss how monetary policy and activity in one country may impact the balance of trade between countries. Discuss how currency arbitrage works and discuss how cryptocurrency arbitrage may impact fiat currency arbitrage.

2.5.3 Retail Banking

Describe the impact of blockchain on retail banks and describe how the banks are using blockchain technology. Identify one or more blockchain networks used by retail banks and include a partial list of participants and the attributes of some of the banking networks.

2.5.4 Central Banks

Describe the role of the central banks (why are they important). How are current trends and the advances of technology changing the need for central banks.

Describe the impact of blockchain on central banks and describe how central banks are using blockchain technology. Also describe some of the various public positions announced by central banks. Describe the concept of stable coins and discuss central banks issuance of stable coins. Discuss how stable coins may impact national economic systems.

2.5.5 International Organizations / Non-Government Organization (NGOs)

Describe how international organizations like the United Nations and the International Monetary Fund are using blockchain technology and what public statements have they made about blockchain and cryptocurrency.

2.5.6 National Governments

2.5.6.1 Cryptocurrency

Discuss how cryptocurrency may impact:

- National economic sovereignty
- Capital flight
- National debt

- Revenue collection
- Monitoring transactions & economic activity
- Alternative revenue sources (mining, smart contract administration)

2.5.6.2 Blockchain

- Discuss how blockchain technology may impact:
  - Revenue collection
  - Government accounting
    - Auditing
    - Accountability
    - Transparency
- Discuss the potential and issuance of government tokens
- Discuss if consensus algorithms could be used to manage national economies or economic activity instead of central banks. Discuss how that might work.

2.5.7 Discuss Tokenomics & Crypto-governance

- Discuss how the money supply and inflation is managed in a cryptocurrency.
- Discuss token generation, air drops, & mining

2.6 Blockchain Executive Consultant Course

The purpose of this course is to help students drive blockchain solutions via organizational strategies. The course is intended to help consultants support business executives or government officials in implementing blockchain technology by meeting business needs and overcoming such obstacles as risks, barriers, and regulations. These objectives will be attained via the review of the following material and creating a skeletal white paper outline to drive the pursuit of an enterprise blockchain solution.

This course is intended to be taught as a master class. That means that while there is some instruction and lecture, the bulk of this course is intended to involve student participation and class exercises where the students teach each other through the interaction of practical exercises.

2.6.1 Blockchain: A New Paradigm or a Fancy Spreadsheet

Discuss why some people call this technology “Transformative” or “Disruptive”. Discuss what does that mean. Discus other

transformative/disruptive technologies or movements. Discuss how other disruptions or transformations have occurred. What was the quality of the leadership? What type of opposition did the face? How easy was it?

Discuss why people call this technology transformative. Discuss how most other technologies facilitate communication and that results in increasingly larger groups of coordinating and control. Better communications have resulted in the consolidation of power from tribes, villages, towns, states, nations and global organizations. However, blockchain facilitates the decentralization of power. What does that really mean? Who will be impacted (positively and negatively)? How will they respond?

2.6.2 Strategic Assessment – Where Are We Now?

It is important for executive consultants to have a clear understanding of the realities of the situation around them. Leaders are constantly approached by individuals and organizations with agendas and who are trying to influence them. In order to make sound recommendations, it is important to separate the hype from the truth. The first module is focused on developing the ability to clearly understand the benefits, risks and constrains of developing and deploying a blockchain solution.

2.6.2.1 Motivation to Implement a Blockchain Solution

Engage the students in a dialog to catalog and discuss the motivations for implementing and deploying a blockchain solution. Specifically consider the motivations from some of the following perspectives:

- Department of Motor Vehicle Administrator
- Elections commissioner
- Energy company executive
- Government contracts management
- Hospital administrator
- Logistics supervisor
- Medical researcher
- State attorney general

2.6.2.2 Business Model Impact

Describe various business models and how blockchain technology may impact various business models.

2.6.2.3 Barriers & Challenges

Engage the students in a dialog to discuss the barriers to implement and deploying a blockchain solution. Specifically consider this from the following perspectives:

- Chief Financial Officer
- Chief Technology Officer
- VP or Human Resources
- Legal Counsel
- Office Manager

2.6.2.4 Exercise: Go/No-Go Decision

Select one of the scenarios in the bullet list below.

- A group of investors in mineral mining companies in the middle east. They are concerned that the integrity of their supply chain is being compromised. They are also concerned that some of the money is being re-directed to hostile actors. They are also concerned that if something is not done, their customers will lose confidence and it will impact their sales and profits.
- You run the Federal Emergency Management Agency (FEMA). The last few major events that your agency managed received widespread criticisms that money was misallocated and poorly managed. Your administration promised to do something about it. However, unless something is done before the next election, there is a significant chance your party will not be re-elected. The next election is in three years.
- You run the state lottery system. Last year, there was a news report about someone tampering with the lottery system and large sums of money missing from the fund. An investigation is under way and while you are not directly involved, you do have fiduciary responsibility over the fund. There are also compliant that the administrative fees to run the fund are very high and that might account for the low balances and the perception of corruption.
- The instructor can create your own scenario that reflects local challenges and opportunities.

Then divide the class into three groups. Each group will separate to an area where they can privately discuss their concerns. The groups are the:

Proponents	Identify the reasons why a blockchain solution **should** be implemented
Opponents	Identify the reasons why a blockchain solution **should-not** be implemented
Management	Identify the strategic business drivers and prioritize the list

The Proponents and Opponents will take turns making their case. First the Proponents, then the Opponents and then each side will have a chance to respond. Then the management committee will consider all the arguments (pro and con) and make their determination. They will brief the class on their decision and justification for why they made the decision.

2.6.3 Paradigm Shifts

Discuss the definition of a paradigm. What are the new paradigms supported by blockchain technology? How will those paradigms shift? Will it be gradual or sudden? What will be the enablers, triggers and results of those paradigm shifts? How will generational and/or cultural differences play into the transformation that may occur?

2.6.4 Blockchain Project Planning

Discuss with the students what is involved in planning a blockchain project and some of the many decisions that need to be made. Discuss the following aspects of planning a project:

- Establishing a project charter
- Establishing an operational concepts and scenarios
- Defining the requirements
- Establish and maintain estimates
- Selecting architectural and development frameworks
- Establishing and maintain communications plans
- Exercise: Blockchain Project Planning

2.6.4.1 *Establishing a project charter*

Discuss with the students what the goals for a blockchain project should be. What should the not be? Based on the current state of the technology, what is the optimal goals, constraints and stakeholders?

2.6.4.2 *Establishing an operational concepts and scenarios*

Discuss what should be included in the description of operational concepts and scenarios. They help the project team establish and maintain a consistent vision for the project. It illuminates and provides context to the gaps between the written requirements and the assumptions that are unstated. They also aid the development team make architectural decisions because they have a better understanding of the nuances of the system.

2.6.4.3 *Defining the requirements*

Discuss with the students the importance of having clearly defined requirements. They are critical to a successful blockchain deployment. Remember to consider both functional and non-functional requirements. Non-functional requirements include performance requirements like response times, security and other no-functional expectations. It is important o fully understand who the stakeholders are (by role) and what their requirements are. The requirements of an admin or a manager may be very different. Consequently, requirements may be defined by role or by business process. Stakeholder roles may also correspond to types of notes.

2.6.4.4 *Selecting architectural and development frameworks*

Discuss the importance of selecting the correct technology platform or stack. Discuss the reasons for or against selecting on of the major blockchain platforms. See the Design paragraph of this document.

2.6.4.5 *Establishing and maintain communications plans*

Discuss why it is important to identify who the stakeholders are and ow you plan to communicate with them. Discuss how various stakeholders may have very different paradigms. Some may be very open to change, and some may resist it. Planning should be done to identify how new concepts and methods will be introduced and integrated into the enterprise environment.

2.6.4.6 Exercise: Blockchain Project Planning

Divide the class into two groups. Each group will be assigned one or the other scenarios:

- You represent a group of musicians that believe that the music industry takes too much of the money earned by the sale of music. You believe that a blockchain based solution could provide artists with greater percentages of music sales and that your team could implement a solution that would incentives people to be part of the system.
- You are the person in a large, global enterprise that is responsible for managing the software licenses for the entire enterprise. You believe that blockchain could be a better solution than the current database that you are using.

As a project team, develop a project plan that includes the following

- Project goals
- High level requirements
- High level design or technical approach
- Estimates of usage that is important for development team.
- Establish and maintain estimates
- Communications Plan

After each team has developed their plan, they will brief the other team.

2.6.5 Review Previous Course Content

Conduct a review of the following topics from the previous courses:

- Blockchain Feasibility – Review those conditions when Blockchain is feasible to use.
- Blockchain Fundamentals:
  - Distributed Networks
  - Key Technology Components
    - Node Roles
    - Block Formation
    - Smart Contracts

    - Ledger
    - Consensus Algorithms
    - Security (Cryptography, Access Control)
    - On-Chain/Off-Chain
- Government & Regulatory Considerations
    - Government Enforcement
    - Legal Requirements (e.g., KYC, HIPAA)
- Business Use Case Summary
- Process Automation
    - Examples: Supply Chain, Contract Management, Case Management, Document
    - Management, Records Management

2.6.6 Capstone Project

Each student is responsible for identifying, developing and presenting their own blockchain based solution to an existing problem. Their presentation (or paper) will include:

- Purpose/Audience
- Sections:
    - Executive Summary
    - Overview of Environment
    - Business Need
    - Solution (Components, Benefits, Risks),
    - Implementation Approach & Activities

This may be part of the class or submitted after the class as a criterion to complete the course.

2.6.7 Course Wrap-Up

Conclude the course with soliciting feedback about their biggest take-away from the course. Please collect course feedback and submit it to GBA along with their roster of students who completed the courses.

Appendix A: Acknowledgements

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