

Government Blockchain Association

Blockchain Consulting Series Course Handbook

Education & Training Working Group

Version: 1.3

 2018-11-14

[1 Introduction 2](#_Toc521369865)

[1.1 Purpose and scope of this Document 2](#_Toc521369866)

[1.2 Distribution 2](#_Toc521369867)

[1.3 Consulting Series Course Goals 2](#_Toc521369868)

[1.4 Course Structure 2](#_Toc521369869)

[1.5 Certifications 3](#_Toc521369870)

[2 Course Learning Objectives 3](#_Toc521369871)

[2.1 Blockchain Foundations 3](#_Toc521369872)

[2.1.1 Introduce the blockchain and why it is important 4](#_Toc521369873)

[2.1.2 Discuss blockchain benefits, risks and use cases 8](#_Toc521369874)

[2.1.3 Discuss ICOs, cryptocurrency creators and users 8](#_Toc521369875)

[2.1.4 Review current real-world use and adoption of blockchain technology 9](#_Toc521369876)

[2.1.5 Introduce smart contracts 9](#_Toc521369877)

[2.2 Cryptocurrencies Rules & Regulations Error! Bookmark not defined.](#_Toc521369878)

[2.2.1 Introduce cryptocurrencies and how they are related to blockchain technology 10](#_Toc521369879)

[2.2.2 Discuss different types and uses of cryptocurrencies. 10](#_Toc521369880)

[2.2.3 Discuss legislation and regulation related to cryptocurrencies 10](#_Toc521369881)

[2.3 Blockchain Solution Architecture Error! Bookmark not defined.](#_Toc521369882)

[2.3.1 Do I need a blockchain? 11](#_Toc521369883)

[2.3.2 Blockchain Solution Considerations 11](#_Toc521369884)

[2.3.3 Consensus Models and Trust Algorithms 12](#_Toc521369885)

[2.3.4 On-Chain Vs Off-Chain Storage Options 2](#_Toc521369886)

[2.4 Managing Blockchain Projects 2](#_Toc521369887)

[2.4.1 Create a business case for a blockchain proof of concept 3](#_Toc521369888)

[2.4.2 Discuss how to assess and mitigate risks related to blockchain projects 3](#_Toc521369889)

[2.5 Transformative Leadership – Through Disruptive Paradigm Shifts Error! Bookmark not defined.](#_Toc521369890)

[2.5.1 Understanding blockchain technology in the context of prior transformative technologies 3](#_Toc521369891)

[2.5.2 Understanding the financial and centralized and societal impact in transitioning from a centralized power to decentralized power. 3](#_Toc521369892)

[2.5.3 Develop a white paper abstract that uses blockchain technology to solve a problem 3](#_Toc521369893)

[3 Acknowledgements 3](#_Toc521369894)

# Introduction

Purpose and scope of the GBA Course Handbook

The GBA Course Handbook is to provide 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. As explained later in the handbook, the consulting series of courses includes the following courses:

* + Blockchain Foundations
	+ Blockchain Technical Consultant
	+ Blockchain Executive Consultant

## Distribution and Approvals

The GBA Training Handbook is intended to be shared with the Education & Training Working Group, GBA Chapter Leadership and GBA Certified Training Providers. As blockchain technology is rapidly evolving, the GBA Training 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 in the GBA Training Handbook. All substantive changes to GBA training material must be approved by the GBA President, GBA Director of Training Programs or any authorized GBA Training Program Team Member.

## GBA Blockchain Certifications – (note for Gerard – this section has to sync with information on GBAglobal.org and Training Provider information)

 1.2.1 The GBA certification program is organized the following way:

* Blockchain Foundations
* Blockchain Technical Consultant
* Blockchain Executive Consultant
1. 1.2.2. While all three courses are independent courses, each course is a prerequisite for the following course. For example, in order to be eligible to register for the Blockchain Executive Consultant Course, the XXX must complete the Blockchain Foundations Course and the Blockchain Technical Consultant Course. As they are independent courses, all three courses do not have to be completed in a consecutive manner. Prerequisites for certifications are valid for a six month period.

 1.2.3. Attendees that complete each of the courses will have their certifications posted on GBAGlobal.org

 1.2.4. Each GBA Blockchain Certification is valid for three (3) years. Certification timeframe may be changed after prior written notice from GBA President or GBA Director of Training.

## Consulting Series Course Goals

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

* Familiarization with the basics of cryptocurrencies and blockchain technology.
* Familiarization with blockchain protocols and technical security requirements.
* Discuss the legal and regulatory framework related to blockchain technology.
* Discuss the architectural and technical issues that must be considered before launching a blockchain development program.
* Review use cases and lessons learned from previous blockchain projects
* Create a blockchain model project in the form of an initial coin offering or blockchain enterprise solution.

## Course Structure

The course will be organized into learning objectives. For example for Day 1:

Course 1: Blockchain Foundations

Lesson 1: Introduce the blockchain and why it is important

Lesson 2: Provide a basic understanding of blockchain technology

Lesson 3: Discuss blockchain benefits, risks and use cases

Lesson 4: Review current real-world use and adoption of blockchain technology

Lesson 5: Introduce smart contracts

Lesson 6: Introduce data storage on blockchain

Course 2: Blockchain Technical Consultant

Lesson 1: Introduce the blockchain and why it is important

Lesson 2: Provide a basic understanding of blockchain technology

Lesson 3: Discuss blockchain benefits, risks and use cases

Lesson 4: Review current real-world use and adoption of blockchain technology

Lesson 5: Introduce smart contracts

Lesson 6: Introduce data storage on blockchain

Course 3: Blockchain Executive Consultant

Discuss the skills and experience needed to effectively manage Blockchain Projects

Discuss the lessons learned from the real life blockchain case studies

Blockchain Business Exercises

* 1. Blockchain Business Track #1 – Develop an Initial Coin Offering
	2. Blockchain Business Track #2 - Develop an Enterprise Based Blockchain Solutions
1. Review and critique the presentations generated from the blockchain business tracks
2. Course Wrap up

# Course Learning Objectives

## **Blockchain Foundations Course**

The purpose of this course is to provide students with a fundamental understanding of the technology and potential use cases. The 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 smart contracts.
* Introduce legal and regulatory considerations.
* Discuss blockchain use cases, benefits, and risks.

They are further explained in the following sub-paragraphs.

### Introduce the history of bitcoin and blockchain technology

Bitcoin White Paper

Satoshi Nakamoto

Important Definitions

Bitcoin and CoinMarketCap.com

Bitcoin created the blockchain

Define the blockchain

How the blockchain works. 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 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.

Blockchain facts v. Blockchain myths

Types of blockchains

Blockchain Platforms

### Discuss why cryptocurrencies and blockchain technology are important

1. Digital Ledger
2. Cryptography
3. Network Communications
4. Government Use cases? (Keep here?)

##### Provide a basic understanding of cryptocurrencies

##### What is money?

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

###  Cryptocurreny Wallets and Exchanges

Discuss the role and functions of wallets, exchanges and how they read from and write to a blockchain. Describe the different types of wallets and exchanges and the features, benefits and limitations of each. Include:

* Wallets (Hardware, software and hosted)
* Exchanges (distributed, private)

#### 2.1.6 What are Cryptocurrencies & Crypto -Tokens

Explain to students that there are many cryptocurrencies, utility tokens and blockchains. Explain how blockchain protocols, platforms and products are layered and the interrelationship between them.

Explain the difference between cryptocurrencies and crypto-tokens

Explain how some blockchains have associated currencies and tokens and other blockchains do not.

ERC 20 Token

Ensure that students understand why blockchain technology is different from previous

protocols 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 choice later on.

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. The blockchain 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 the transaction.

#### Provide a basic understanding of blockchain technology

Students should be exposed to the basic concepts of the bitcoin blockchain as an example of “A” 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 for proof of work
* The amount of guessing required to find a nonce small enough is periodically calculated every so many blocks to take a regular amount of time
* The miner adds the new block which connects to the former block of the blockchain
* The new block distributed to all the nodes on the bitcoin network
* Nodes use the rules of the blockchain to confirm it is valid
* The node communicates the status of the blockchain to the other network nodes

Students should be reminded that this is just an example of a popular blockchain and that there are many other variations. Other types of blockchain technologies are presented during the Blockchain Technology Course.

* + In other distributed ledger technologies, transactions may not be organized in blocks
	+ In other distributed ledger technologies, blocks might not be regular

Describe the five properties of the blockchain:

* Decentralized systems
* Distributed ledger
* Safer & secure ecosystem
* Mining is used to validate blocks of transactions
* Transactions are immutable

Explain that blockchain technologies is important because:

* The rate of blockchain interest and application is growing rapidly
* Blockchain solutions have such a wide scope of application
* Blockchain technology could bring huge efficiencies to existing business processes by eliminating intermediaries and streamlining business processes.

Describe the benefits of using a blockchain solution. Describe how a blockchain solution can provide:

* Shared common view of the transaction history and status of transactions
* Security of transaction integrity
* Transparency, openness, and trust

Describe the risks of using a blockchain solution. Describe how a blockchain solution can result in the following risks

* Solutions may not be scalable
* Theft or loss of digital assets
* Legal and regulatory violations, fines, or other enforcement activity

### Introduce smart contracts

* What are smart contracts? Based on Ethereum
* The value of smart contracts
* Smart contract challenges
* Introduction of Decentralized Autonomous Organizations

### 2.1.6. Discuss ICOs, cryptocurrency creators and users

Define and describe Initial Coin Offering (ICO) including:

* + Price and volatility issues.
	+ What impacts the price of cryptocurrencies and tokens?
* Discuss the topic of crypto economics in terms of supply, demand and governance models to manage the supply and demand of tokens and the impact on price.
* Role of the SEC in the ICO process

#### Introduce legal and regulatory considerations

Describe to students blockchains contain five properties. They are:

* State Legislation
* Proposed Legislation
* SEC Enforcement Actions
* IRS Enforcement

Identify any specific regulatory or legal requirements and impact on cryptocurrencies and blockchain related to:

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

#### Discuss blockchain use cases, benefits and risks

#### Use Cases

There are three primarily uses for blockchains. They are Cryptocurrencies, Utility Tokens and Process Automation. They are briefly described below:

|  |  |
| --- | --- |
| * Cryptocurrencies
 | A special kind of virtual currency that reside on existing blockchains and represent an asset or utility. |
| * Utility Tokens
 | A special kind of virtual currency that reside on existing blockchains and represent an asset or utility. |
| * Process Automation
 | The use case of blockchain technology and smart contracts to eliminate the need for middlemen to enforce contracts, verify transactions, or perform background checks. This serves as basis for fully automating the business processes and manage new technology embedded in the process. |

Describe how blockchain solutions could be used to for a variety of use cases associated with GBA working groups listed here: [www.gbaglobal.org/working-groups](http://www.gbaglobal.org/working-groups). Any use case described on the GBA slides should also be uploaded as a blog enter on the GBA website. Blogposts can be uploaded by any GBA Professional Member. All use cases on slides must have a link to the blog post on the GBA site with additional details including source information and other validating content.

### Review current real-world use and adoption of blockchain technology

Training should include local examples of blockchain adoption. When possible, use specific companies that are GBA members. GBA Corporate Members can be found on the [www.GBAglobal.org](http://www.GBAglobal.org) site. Specific companies can be found in domain specific directories on the site. For example:

|  |  |
| --- | --- |
| Domain | GBA Organizational Directory |
| Energy | [www.gbaglobal.org/organizations/categories/energy](http://www.gbaglobal.org/organizations/categories/energy) |
| Identity Management | [www.gbaglobal.org/organizations/categories/identity-management](http://www.gbaglobal.org/organizations/categories/identity-management) |
| Records Management | <https://www.gbaglobal.org/organizations/categories/records> |
| Supply Chain Management | [www.gbaglobal.org/organizations/categories/supply-chain-management](http://www.gbaglobal.org/organizations/categories/supply-chain-management) |
| Voting | [www.gbaglobal.org/organizations/categories/voting](http://www.gbaglobal.org/organizations/categories/voting) |

END OF FOUNDATIONS COURSE

##

## **Blockchain Technical Consulting Course**

* Review Blockchain Information Covered in the Foundations Course
* Use a Blockchain v. Don’t Use a Blockchain

 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 help to address that question, including:

* D. Birch Model
* Birch-Brown-Parulava Model
* B. Suichies Model
* Sebastien Meunier 2017 Model
* Ethereum Abstract – First Paragraph
	+ “When Satoshi Nakamoto first set the Bitcoin blockchain into motion in January 2009, he was simultaneously introducing two radical and untested concepts. The first is the "bitcoin", a decentralized peer-to-peer online currency that maintains a value without any backing, intrinsic value or central issuer. So far, the "bitcoin" as a currency unit has taken up the bulk of the public attention, both in terms of the political aspects of a currency without a central bank and its extreme upward and downward volatility in price.”
	+ Describe how the Ethereum White Paper evolved the blockchain from a technology that supported Bitcoin to a broader use for recording all types of transactions.
	+ Describe the DAO Hack and why it is important
* Blockchain Governance Models
	+ Describe Blockchain Protocol Management
		- Selecting the correct protocol is extremely important.
		- Define protocols
		- How protocols are they established, used, and managed.
		- Select several protocol examples from the GBA publication library at [www.gbaglobal.org/resources/categories/protocols](http://www.gbaglobal.org/resources/categories/protocols)
	+ Cryptography
		- Describe the difference between encryption and hashing.
		- Encryption is an approach that helps to keep data secure. The encrypted data is encoded or changed up to some extent before it is sent out of a network by the sender and only authorized parties can access that information. In Blockchain, this approach is useful because it simply adds more to the overall security and authenticity of blocks and helps to keep them secure.
		- Hash functions are valuable because they take arbitrary data and produce an output that:
			* is of fixed size
			* varies completely randomly
			* Has as few collisions as possible, given its output size
			* Is infeasible to reverse

Use the SHA-256 Hash function as an example of how cryptography is used in the bitcoin protocol. Explain that the SHA-256 Hash Function takes inputs of a variable length and converts it into a 256 bit Hexadecimal format.

* + - Public and private keys - Using public and private keys are the core of digital signatures.

##### Mining

* + - Describe blockchain mining in a proof of work system; whereby new transactions are continuously collected into a pool, hash functions with different nonce values are regularly calculated, and a block is only valid if it has a sufficiently small hash output value, which varies randomly and thus proves work was done to achieve.
		- Describe blockchain mining in a proof of stake system; whereby new transactions are continuously collected into a pool, coin holders may regularly and easily calculate new blocks, but only one new block at a time may be accepted, and the probability of a stakeholder successfully publishing a block is proportional to the amount of coins he/she owns.
		- Explain why it is so difficult (if not impossible) to alter information once it has been added to the blockchain. Explain the 51% attack.
	+ Design
		- Survey of protocols
			* Identify the major blockchain protocols and describe their technical attributes including
				+ Type
				+ public,
				+ permissioned,
				+ private

|  |  |
| --- | --- |
| 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. |
| Consortium (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, and 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 write permissions are kept centralized to one organization. Read permissions may be public or restricted to an arbitrary extent. |

#### What Platform

* + - * + Describe some of the platform choices available. Describe alternative distributed architectures including DAGs (eg Hashgraph, IOTA) and Holochains.

#### What Product (Build, Buy or Re-Use Analysis)

* + - * + Discuss some of the blockchain infrastructure products that could be used as components to new systems. For example, there are already off-the shelf products that may be integrated into ne systems and solutions. Use products that are listed in this GBA Directory: <https://www.gbaglobal.org/applicationsproducts/categories/product>
				+ Types of consensus algorithms
				+ Proof of Work
				+ Proof of Stake
				+ Proof of Activity
				+ Proof of Burn
				+ Proof of Capacity
				+ Proof of Elapsed Time
				+ Proof of Integrity
				+ etc
				+ block size
				+ block time
				+ capacity
				+ Describe how the protocols supports smart contracts
				+ Other attributes that may impact protocol selection

Flexibility with membership

Compute equity

Shared business interests

Governance

* + Describe hard v. soft forks
		- Define hard fork
			* Bitcoin Hardforks (Ex – Bitcoin Cash, Bitcoin Gold, Bitcoin Private, Bitcoin Interest, Bitcoin XT, Bitcoin Classic, Bitcoin Unlimited, etc)
			* Ethereum DAO Hack
			* Define soft fork - a change to the bitcoin protocol wherein only previously valid blocks/transactions are made invalid.
* Development methodologies applicable to blockchain implementations
	+ Examples include: Agile, Waterfall, and Iterative
* System development phases
	+ Requirements
		- Elicitation & Gathering
			* Business needs
			* Functional
			* Non-Functional
		- Requirements Analysis
			* Bi-Directional Traceability
			* Operational Concept & Scenarios
			* Interface Management
		- Requirements Management
			* Requirements baselines
			* Change Control
		- Communications (transactions, messages, status updates)
		- Blockchain architecture
		- Security
		- Data/Record Management
			* Describe the two types of records on a blockchain (block records and transactional records).
			* “On Chain” v. “Off Chain” Record Management”
		- Infrastructure requirements for blockchain solutions
		- Resources
		- Cost Impacts of design alternatives
	+ Development Tools
	+ Examples include: Solidity, GO, Javascript, C/C#/C++, Rust, Python, Perl, etc.
	+ Implementation (distributed systems)
	+ Test
		- How should blockchain projects be tested (differently than traditional projects)
		- Intra-node
		- Inter-node
		- Smart contract auditing
	+ Deployment (adoption)
		- Ongoing operation and administration of the blockchain network (and the prevention of hard forks)

### Review current real-world use and adoption of blockchain technology

## **Blockchain Executive Consulting Course**

Discuss the skills and experience needed to effectively manage Blockchain Projects

Discuss the lessons learned from the real life blockchain case studies

Blockchain Business Exercises

* 1. Blockchain Business Track #1 – Develop an Initial Coin Offering
	2. Blockchain Business Track #2 - Develop an Enterprise Based Blockchain Solutions

 Discuss the skills and experience needed to effectively manage Blockchain Projects

* + General Project Management
	+ Use the learning from the GBA Blockchain Foundations and Technical Consulting Courses
	+ Focus on the areas related to the blockchain were you have existing expertise
		- Mining
		- Security
		- Investing
		- Programming
		- Consulting
		- Marketing
		- Legal/Regulatory
		- Initial Coin Offerings (ICOs)
	+ Steps for a Successful Blockchain Project
		- Initiation
		- Planning
		- Design
		- Development
		- Testing
		- Deployment
		- Support
	+ Project Management Case Study
		- Lessons Learned
	+ The Importance of User Experience

Discuss the lessons learned from the real life blockchain case studies

* Blockchain Lessons Learned #1 (ICO)
* Blockchain Lessons Learned #2 (Security)
* Blockchain Lessons Learned #3 (Enterprise Solution)
* Blockchain Lessons Learned #4 (Class Knowledge)

 Blockchain Business Exercises

* 1. Blockchain Business Track #1 – Develop an Initial Coin Offering
	2. Blockchain Business Track #2 - Develop an Enterprise Based Blockchain Solutions

 The blockchain business exercises should start no later than lunch. Prior to lunch, the attendees should select the ICO or the Enterprise Track. There should be no more than six (6) attendees in each group. The instructor(s) should give them the instructions and let them work through lunch. When they get back from lunch, each group should present their idea to the instructor(s) and class for feedback. After the ideas have been approved, the groups can design the outline for the white paper to support their blockchain idea.

* 2.3.4 Review and critique the presentations generated from the blockchain business tracks
* 2.3.5 Course Wrap up

### Create a business case for a blockchain proof of concept

### Discuss how to assess and mitigate risks related to blockchain projects

### Understanding blockchain technology in the context of prior transformative technologies

### Understanding the financial and centralized and societal impact in transitioning from a centralized power to decentralized power.

### Develop a white paper abstract that uses blockchain technology to solve a problem

The purpose of this course is to help students integrate blockchain capabilities into organizational strategic missions, visions, and plans.  The course is intended to help executives anticipate risks and barriers as well as develop strategies to overcome obstacles and successfully deploy blockchain solutions traditional challenges.  The learning objectives for this course should enable students to:

1. Understand the linkage between business needs to blockchain solutions
	1. Understanding blockchain capabilities & limitations
	2. Knowing which blockchain solution matches particular business needs
2. Planning blockchain projects
	1. What makes blockchain projects different
		1. Smart contracts
		2. Immutability
		3. Using tokens – legal & regulatory risks
		4. Fear, uncertainty, and doubt
	2. Planning blockchain project
		1. Establishing management processes
			1. Scope and requirements management
			2. Stakeholder management
		2. Estimating
			1. Resources
			2. Schedule
			3. Costs
		3. Identifying risks & determining mitigations and contingencies
	3. Managing & tracking blockchain projects
		1. Using smart measures
		2. Blockchains, EVM and information integrity
	4. People, politics, and adversity
		1. Understanding the source and categories of resistance to blockchain technologies
		2. Understanding the nature and magnitude of resistance to transformative implementations
		3. Establishing effective responses to adversity
		4. Understanding the leadership qualities and attributes to implement transformative change with blockchain technology

# Acknowledgements

Special thanks to the following individuals for reviewing this document and providing meaningful feedback.

* Eric Guthrie
* Anjana Mirajkar
* Atul Marathe
* Gerard Dache
* Jonathan Lehman
* Randall Pires
* Robert Perry
* Bryant Neilson
* Armand Gaetan Ngueti
* Nabeel Malik
* Piers Casimir-Mrowczynski