



# A

## **Applying blockchain concepts to the vehicle manufacture lifecycle use case: Sample answers**

This appendix provides examples of answers to the tasks that you performed in Chapter 1, “Exercise 1: Applying blockchain concepts to the vehicle manufacture lifecycle use case” on page 1.

## Identifying participants: Sample answers

Identify the participants in the blockchain network that is described in 1.2, “Vehicle Manufacture lifecycle use case overview” on page 2.

1. List the participants in the use case business network and describe their role:
  - Paul: The buyer and owner of a car.
  - Mike: An employee for the car manufacturer. Mike works for the Arium organization.
  - Debbie: An administrator for the regulator that is called the VDA.
  - Tommen: An insurer from an insurance company.
2. Provide examples of the type of data that each participant should be able to see and the transactions that they should be able to submit based on the needs of their roles:
  - Paul (buyer) should be able to see the details and status for his order, but he should not be able to see other buyer's orders. He should be able to submit an order.
  - Mike (vehicle manufacturer) should be able to see all the orders that are submitted to Arium, but he should not be able to see orders that are submitted to other vehicle manufacturers. He should be able to update the order as the vehicle moves through the factory floor.
  - Debbie (regulator) should be able to see information that ensures that the regulations have been met for all vehicles in the network regardless of who bought them or who manufactured them. Debbie should not be able to see personal information about Paul, such as his credit score and physical features. Debbie should be able to impose penalties if the vehicle manufacturer does not conform to regulations. Debbie should not be able to update the status of an order.
  - Tommen (insurer) should be able to see Paul's driving record, and the characteristics of the vehicle he is buying. Tommen should be able to see this information for buyers that request an insurance policy from his insurance company regardless of who manufactures the vehicle. Tommen should not be able to see the orders that are submitted to Arium if the buyers are not requesting insurance from him. Tommen should be able to approve or reject requests for insurance policies.
3. Describe the characteristics and type of blockchain network that is used in this use case, that is, a private and permissioned blockchain network.

The vehicle manufacture lifecycle use case is an example of a private blockchain network. A private blockchain network requires an invitation and must be validated by either the network starter or by a set of rules that is put in place by the network starter.

Businesses who set up a private blockchain generally set up a *permissioned* network, which places restrictions on who may participate in the network, and only in certain transactions.

Participants must have an invitation or permission to join. The access control mechanism might vary. For example, existing participants might decide future entrants, a regulatory authority might issue licenses for participation, or a consortium might make the decisions. After an entity has joined the network, it plays a role in maintaining the blockchain in a decentralized manner.

4. Provide examples of contractual agreements between participants:
  - Paul (buyer) agrees to pay for the vehicle upon delivery and Mike (vehicle manufacturer) agrees to fulfill the order per Paul's specifications.
  - Mike (vehicle manufacturer) agrees to follow the regulations that apply to the vehicles that are built by Arium.

5. Provide examples of other participants that are not listed in Vehicle Manufacture lifecycle use case overview that might potentially be interested in joining this business network:
  - Police looking for potential crime in the blockchain network by looking at the information that is stored about all of the vehicles.
  - A scrap dealer looking for vehicles that are marked as offload and is interested in buying junk vehicles and selling the scrap steel for a profit.
  - Vehicle part supplier.
  - An automobile transport organization that transports the vehicle from the manufacturer to the buyer.

## Identifying assets: Sample answers

Identify the assets in the blockchain network that is described in 1.2, “Vehicle Manufacture lifecycle use case overview” on page 2:

1. List the assets in the use case business network:
  - Vehicle.
  - Order.
  - Insurance policy.
2. Provide examples of attributes and characteristics for each asset:
  - Vehicle (tangible asset): Model, trim, color, extended warranty, tinted windows, and owner.
  - Order (non-tangible asset): Order ID, vehicle being ordered, status of the order, and buyer.
  - Insurance policy (non-tangible asset): Damage expenses coverage, discounts and special rates, and car rental coverage.
3. Provide examples showing assets being updated through the use case and exchanged between participants:
  - Vehicle is built as it moves through the factory floor and is transferred from the manufacturer to the buyer.
  - Order is updated from the time the buyer submits the order for a new vehicle to the moment the vehicle is delivered.
4. Explain how asset ownership and asset transfer are maintained in business networks that do not use blockchain technology.
 

In business networks that do not use blockchain, each participant keeps their own ledgers, which are updated to represent business transactions and any updated asset information. It is *expensive* due to duplication of efforts and intermediaries adding margin for services. It is *vulnerable* because if a central system (for example, a bank) is compromised, it affects the entire network. Each participant must maintain their own ledger for every business network to which they belong, which makes *scalability challenging*, and the solution difficult to maintain and integrate as it evolves. It is *inefficient* because participants do not have an instant updated view of the ledgers that are owned by others.
5. Explain how asset ownership and asset transfer are maintained in blockchain solutions.
 

In a blockchain network, all transactions are recorded in a *single, shared, and distributed ledger*. Participants in the network govern and agree by *consensus* on the updates to the records in the ledger. No central authority or third-party mediator, such as a financial

institution or clearinghouse, is involved. Every record in the distributed ledger has a time stamp and unique cryptographic signature, thus making the ledger an auditable, immutable history of all transactions in the network.

## Identifying applications: Sample answers

Identify the applications in the blockchain network that is described in 1.2, “Vehicle Manufacture lifecycle use case overview” on page 2:

1. List the applications that the participants in the Vehicle Manufacture lifecycle network use to interact with the blockchain network:
  - Vehicle-buying mobile app (buyer)
  - Manufacturer dashboard (manufacturer)
  - Regulatory dashboard (regulator)
  - Insurance dashboard (insurer)
2. Describe the blockchain component (which defines the business rules) that applications use to create proposed transactions.

*Smart contracts* are used to encode and encapsulate the transaction rules and processes that govern transactions. When the transaction is processed, the smart contract automatically performs actions and compliance checks according to the rules that they have defined.

## Identifying transactions: Sample answers

Identify the transactions in the blockchain network that is described in 1.2, “Vehicle Manufacture lifecycle use case overview” on page 2:

1. Provide examples of transactions in the Vehicle Manufacture lifecycle use case.
  - Place Order: Buyer submits an order to purchase a new vehicle.
  - Update order status: The manufacturer updates the order status as the order is processed, for example, SUBMITTED, RECEIVED, IN PROGRESS, and DELIVERED.
  - Update Vehicle Owner: Regulator changes the vehicle owner from the manufacturer to the buyer after the contractual agreements are met, and the car is paid for and delivered.
  - Request Insurance: The owner requests insurance from an insurance company.
2. Describe the blockchain component where transactions are recorded.

The transactions are recorded in a *shared permissioned ledger*.
3. Describe the process by which the participants in the network approve a proposed transaction.

Network participants agree how transactions are verified through *consensus*. Consensus means that all participants agree that a transaction is valid.

## Identifying events: Sample answers

Identify examples of events in the blockchain network that is described in 1.2, “Vehicle Manufacture lifecycle use case overview” on page 2:

1. List at least two examples of events in the Vehicle Manufacture lifecycle network.  
Vehicle overheating event, crash event, update order status, or place order.
2. Provide examples of business processes that can be triggered by those events:
  - A vehicle overheating event can automatically start an investigative process in the manufacturer systems to determine whether this a common failure or an isolated incident.
  - A crash event can trigger insurance processes to handle the crash and the claims that the owner might raise.

## Identifying external system integration: Sample answers

Identify examples of integration with external systems in the blockchain network that is described in 1.2, “Vehicle Manufacture lifecycle use case overview” on page 2:

1. Provide an example of integration with external systems in the Vehicle Manufacture lifecycle network where data flows from the external system to the blockchain business network.  
Information that is collected from the IoT devices that are installed in the vehicle is fed back into the network for everyone to see it.
2. Provide an example of integration with external systems in the Vehicle Manufacture lifecycle network where data flows from the blockchain business network to the external system.  
Information that is recorded in the blockchain network when the order is submitted can be passed to the manufacturer's ERP systems.

## Identifying requirements and benefits: Sample answers

Identify requirements that the participants in the Vehicle Manufacture lifecycle network might have, explain how blockchain addresses those requirements, and describe the associated benefits:

1. Provide examples of requirements that Paul the car buyer, Mike the vehicle manufacturer, Debbie the regulator, and Tommen the insurer might have:
  - Paul (buyer) wants to be sure that only participants with a “need to know” have access to his personal information.
  - Paul wants to be sure that his car is being manufactured by Arium and has original parts.
  - Debbie (regulator) wants to be sure that all incidents in the lifecycle of the vehicle are recorded and tracked so she can be sure that regulations are met. She wants to have this information instantly without the delays that are caused by paperwork flowing from the manufacturer or insurer to the regulator.

- Mike (manufacturer) wants to make sure that all the transactions in the business network abide by the rules in the contractual agreements between Arium and all other participants (for example, buyers and suppliers).
- Tommen (insurer) wants to make sure that all incidents of reckless driving are recorded and never removed or altered.

2. Explain how blockchain addresses the participants' requirements.

Blockchain networks provide the following capabilities and components that address the participants' requirements:

- Immutable shared ledger: Append-only distributed system of record across the business network. Records cannot be deleted after they are added to the ledger.
- Accountability: Network members are known. All records that are added to the ledger include the origin (who created it). Assets, data, and transactions in the immutable ledger have a verifiable audit trail. Each partner is held accountable for their individual roles in the overall transaction.
- Permissions: Participants are assigned permissions so that they can do only what they are allowed to do.
- Privacy: Although members are known to the network, transactions are shared only with members that have a need to know.
- Conditional transactions: Transactions are added to the ledger only if participants agree by consensus that the proposed transaction meets the contract terms that are specified and verified by the smart contract.
- Smart contract: Business rules and terms that are implied by the contract are embedded in the blockchain and run with transactions.

3. Provide examples of the benefits of using blockchain technology in the Vehicle Manufacture lifecycle network.<sup>1</sup>

Examples of the benefits that blockchain technologies bring to business networks are:

– Security

The method by which transaction records are validated and added to a blockchain is inherently more secure than other record-keeping systems. In order for a transaction to be approved, participants must agree on it through consensus. Then, the transaction is encrypted and linked to the previous transaction, which creates an immutable chain that is impossible to modify retroactively because it requires the alteration of all subsequent blocks and the collusion of the entire network.

– Traceability

When assets are exchanged on a blockchain, the transaction record provides an audit trail that shows the provenance of the asset. This benefit is especially useful in a supply chain, where components can be tracked along their journey. Information relating to the component can then be relayed to or from the new owner for possible action. The historical transaction data can also help to verify the authenticity of assets.

– Transparency

On a blockchain network, data is complete, accurate, and consistent across participants. Through the distributed ledger structure, transaction information is accessible to all relevant users, which makes it possible for network members to build a stable business relationship based on transparency and trust rather than negotiation.

– Documentation: Compliance and clarity without costly clutter

<sup>1</sup> <https://www.ibm.com/blogs/blockchain/2017/11/seven-reasons-to-be-thankful-for-blockchain/>

Traditionally, keeping accurate records of monetary and asset transactions is a paper-heavy, time-consuming process that is prone to human error and often requires third-party mediation. With blockchain, record-keeping is performed by using a single digital ledger that is shared among participants, which reduces the clutter and complications of using multiple ledgers that must be reconciled.

- Effectiveness and efficiency

Blockchain helps to streamline and speed up processes. With a better process, there is less time that is spent on administrative tasks and more opportunity to streamline and automate. Tasks can occur much quicker without numerous intermediaries, and transactions can be processed around the clock, which frees up time and capital for the business.

- Eliminating middlemen and intermediaries

Blockchain is decentralized, which offers the promise of nearly friction-free cooperation between participants of business networks. Enhanced security makes it possible for these users to interact directly with each other because trusted intermediaries and middlemen are not needed to confirm transactions.

- Reduced cost

With better organization, increased efficiency, and fewer intermediaries, companies can reduce everyday costs such as third-party fees, administrative costs, and other costs for exchanging assets.