

BLOCKCHAIN FOR CONSTRUCTION MANAGEMENT

October, 2019



Blockchain for construction management

› Introduction

- › **Name:** Nguyen Tung Anh
- › **Location:** Viet Nam
- › **University:** Korea University
- › **Mentor(s):** George Blumberg
- › **Hyperledger project:** Blockchain for construction management



Blockchain for construction management

Project Description: Construction Management Blockchain is a project of Hyperledger Summer Internship Program 2019 which provides a way to apply Hyperledger for construction and engineering (C&E), while literature research and practical simulation prove Hyperledger as one of best platform for C&E.

This project was conceived to test the potential of blockchains. To do this, a prototype system is used to model real-world commercial process by defining the properties of participant attributes superimposed with algorithms that describe their trading relationships. These are implemented using so-called *smart-contracts* that make use of the latest features of Hyperledger Fabric (HLF) and Composer, to model commercial relations between traders in a trust network. Using HLF, a variety of benefits can be obtained. For example, the scheduling, confirmation and commissioning of installed components at a construction site can be recorded and therefore, managed. But management of a HLF network is a demanding job and good design is essential to allow confidential trading to take place. The access control list (ACL), included within Composer, provides the tools to create, read, update, or delete elements within the commercial network's domain model. The project has advanced this control by making use of application programming interface (API) to connect to Web servers that in turn can provide analysis and management applications. This links to common project management tools, notably Gantt charts and other projects metrics such as individual work rates, cost and budgetary items that can be used in reports and figures.

Tools: Hyperledger Fabric, Hyperledger Composer, Node.js, javascript.

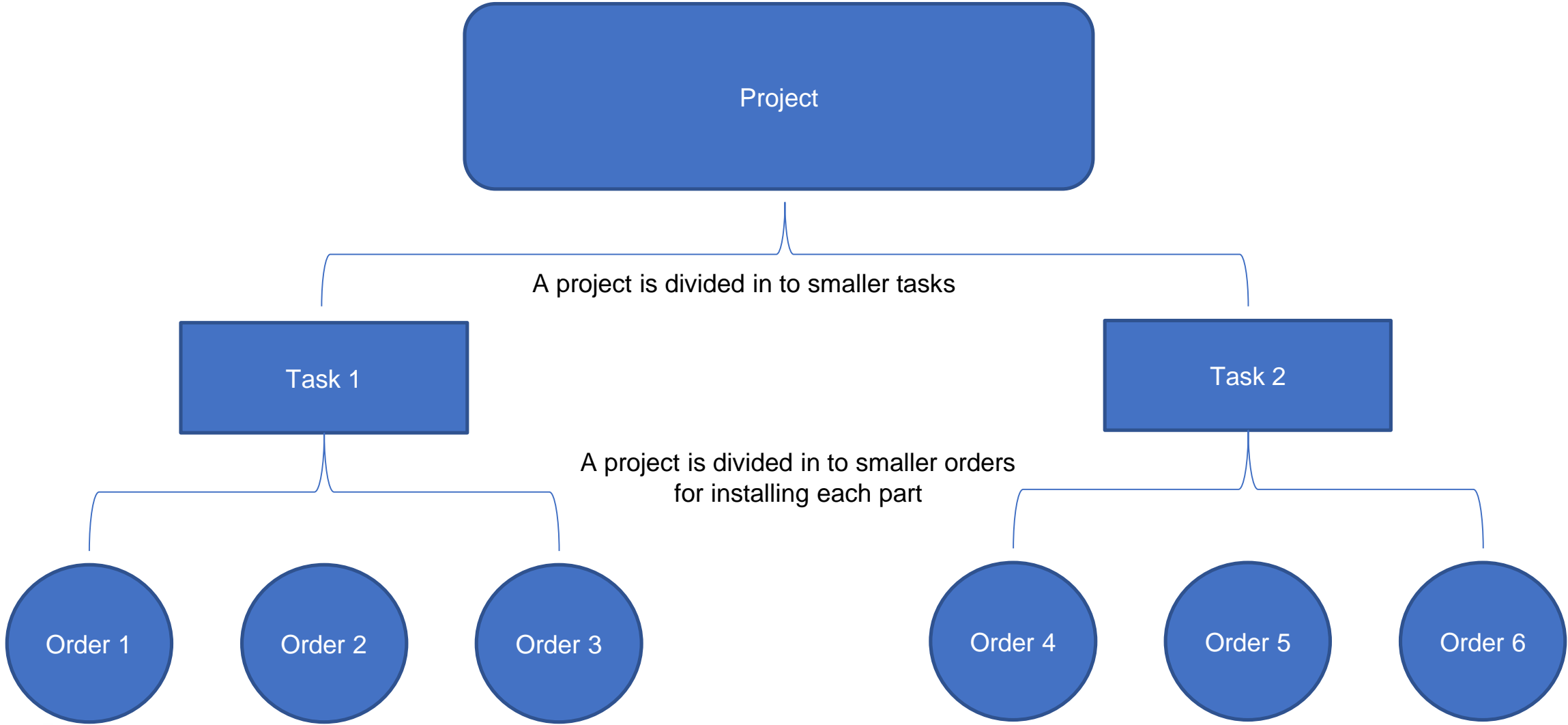
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› Project Objectives:

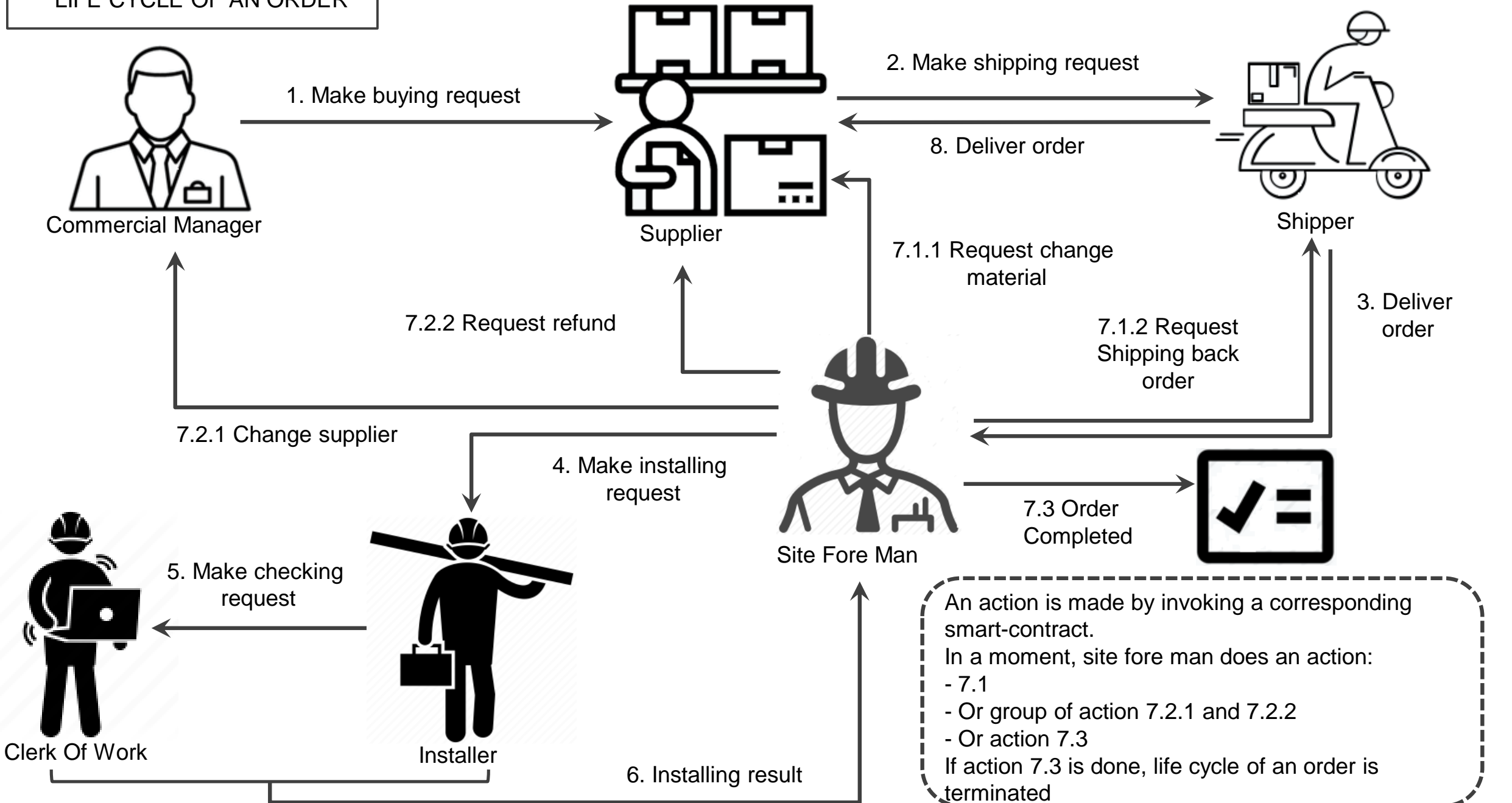
- › **Obj 1:** Confirm that Hyperledger Fabric (HLF) is a suitable blockchain platform for use on C&E projects and that Hyperledger Composer (“Composer”) is suitable for creating the business model and managing the network
- › **Obj 2:** Design and confirm a system architecture and network configuration for a blockchain solution that is able to support C&E projects.
- › **Obj 3:** Establish a set of functions of C&E assembly and administrative processes that are suitable for the application of HLF.
- › **Obj 4:** Using an established set of business process modelling tools, define a pilot project that will be used to test the system.
- › **Obj 5:** Design and testing programme that can be used to fully evaluate the utility and reliability of a HLF network for the pilot project.



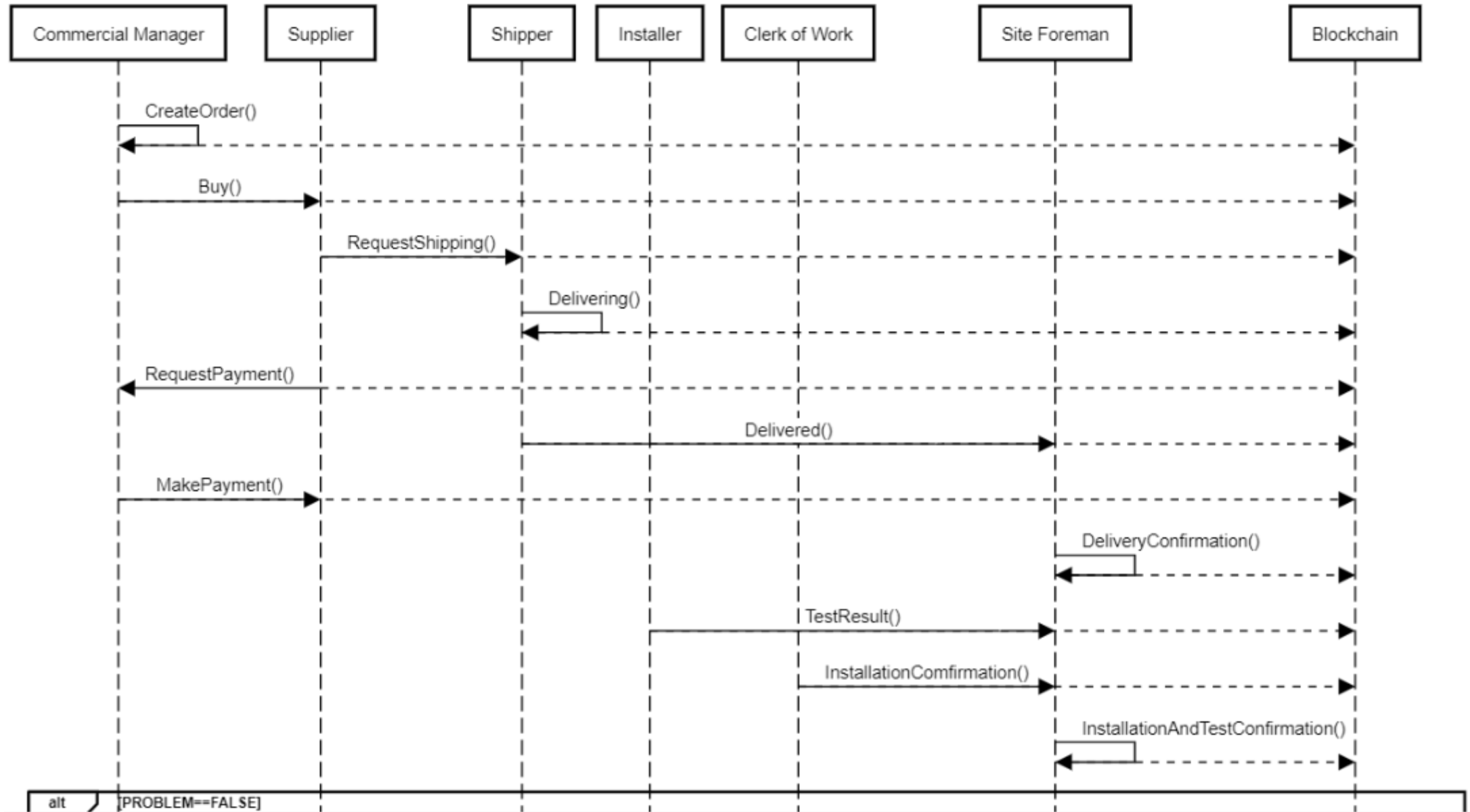
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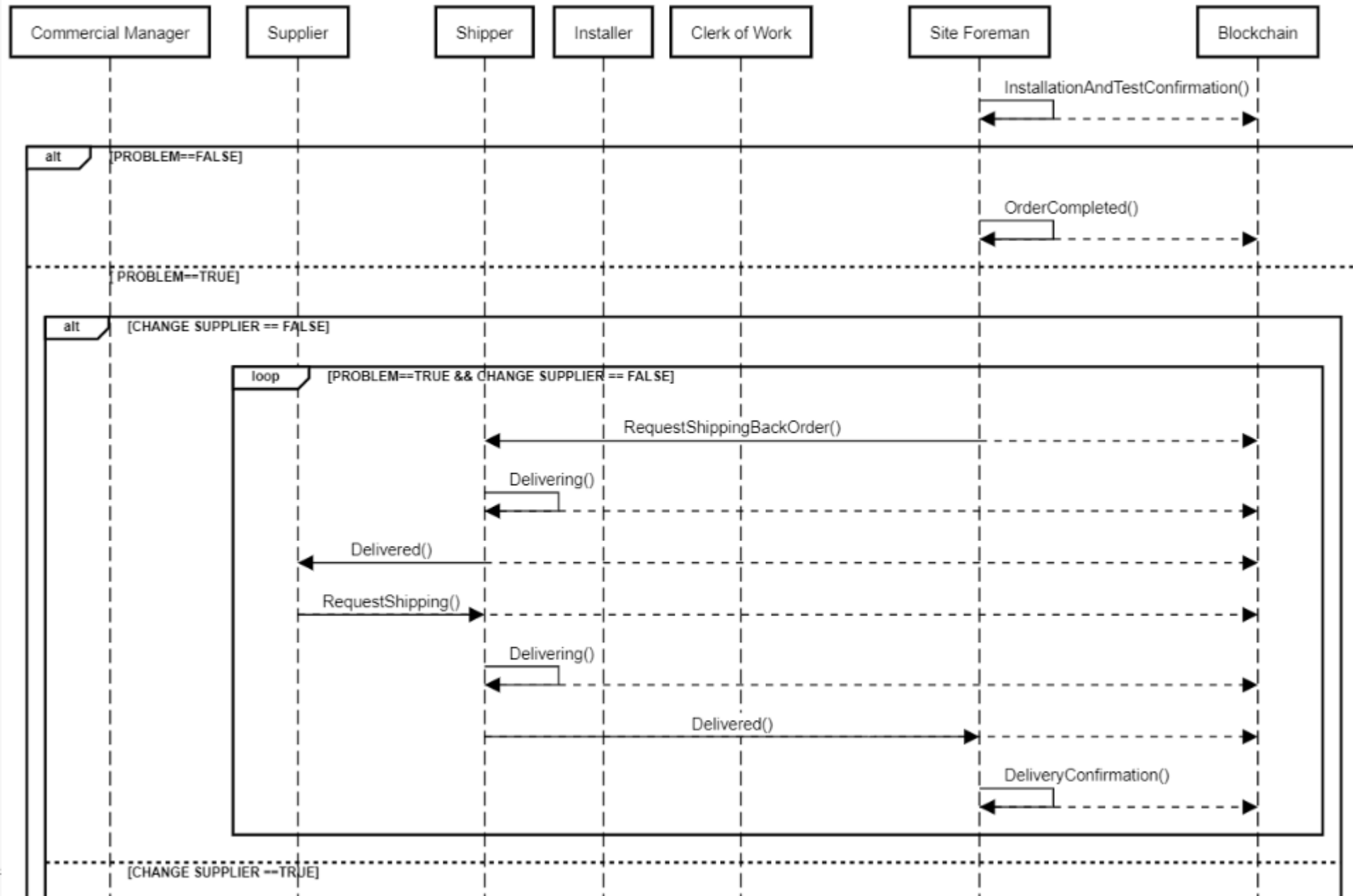
LIFE CYCLE OF AN ORDER



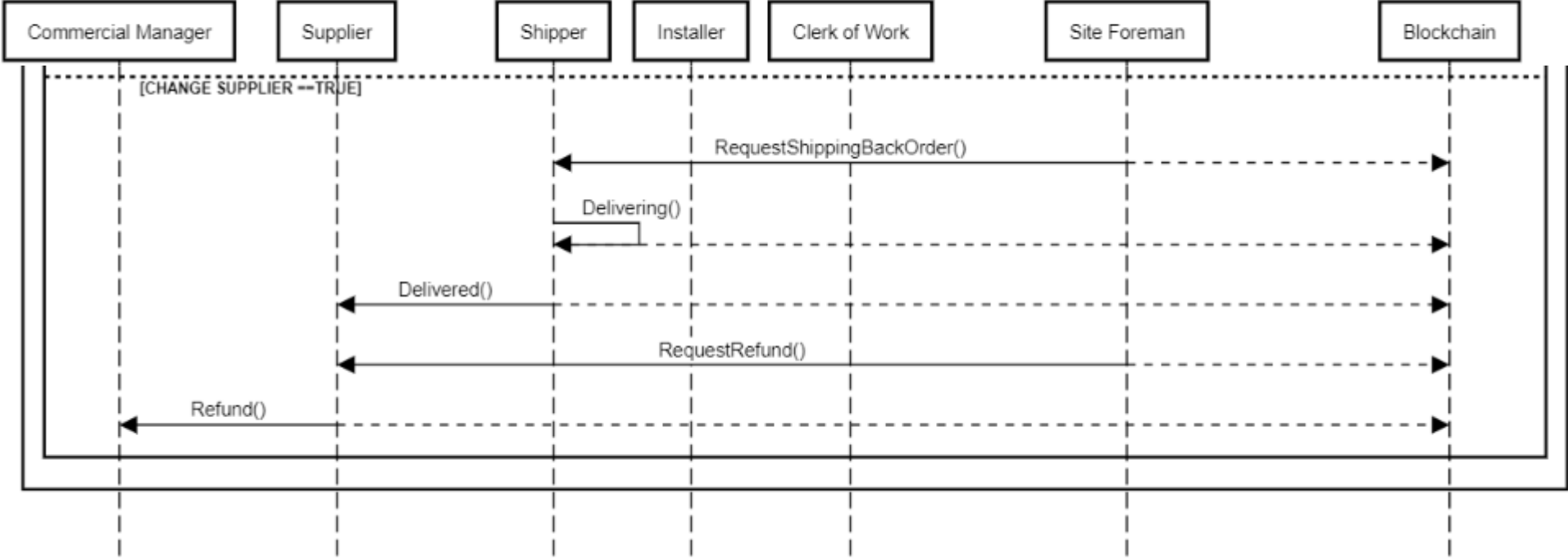
SEQUENCE DIAGRAM FOR CONSTRUCTION MANAGEMENT

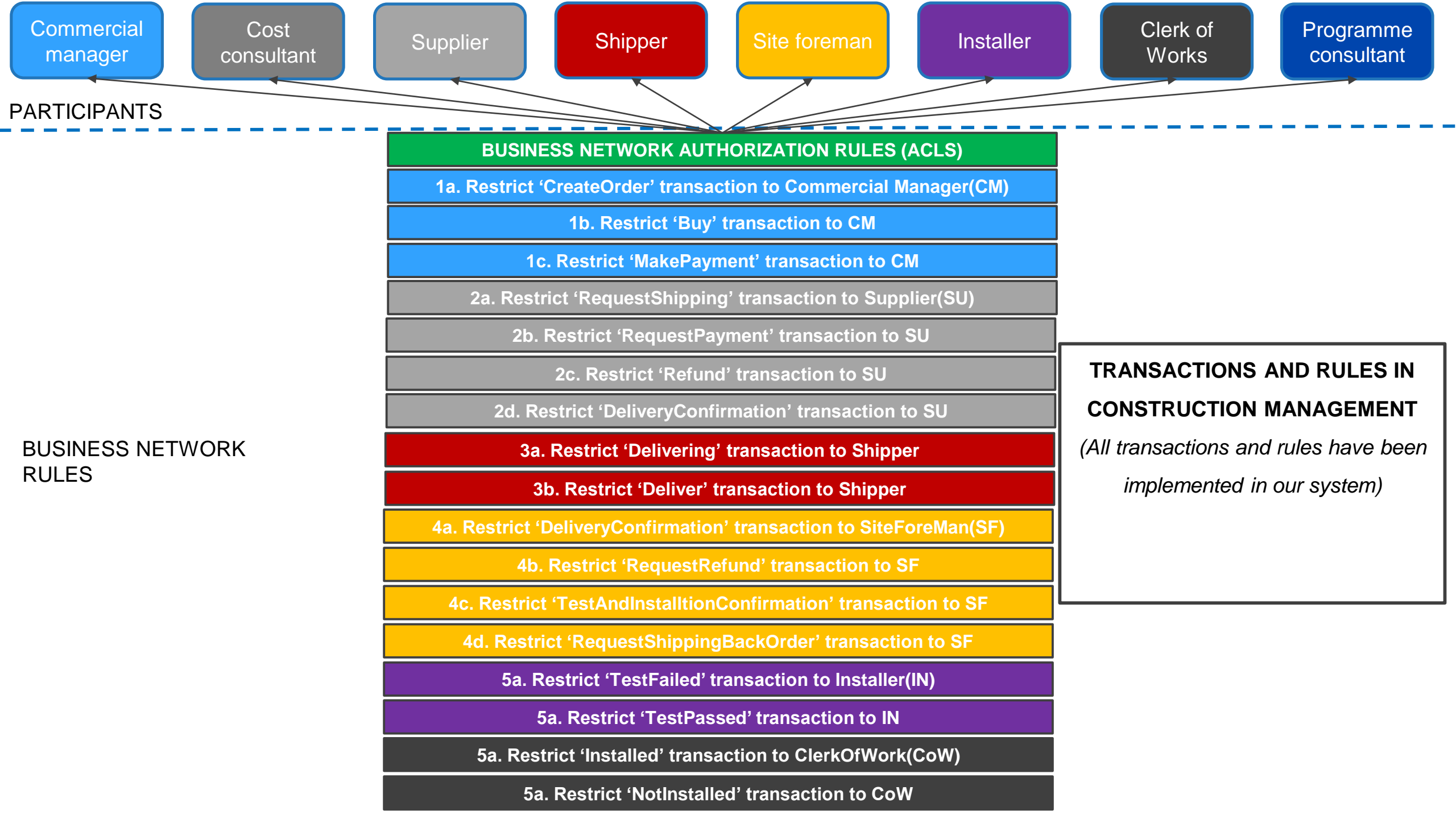


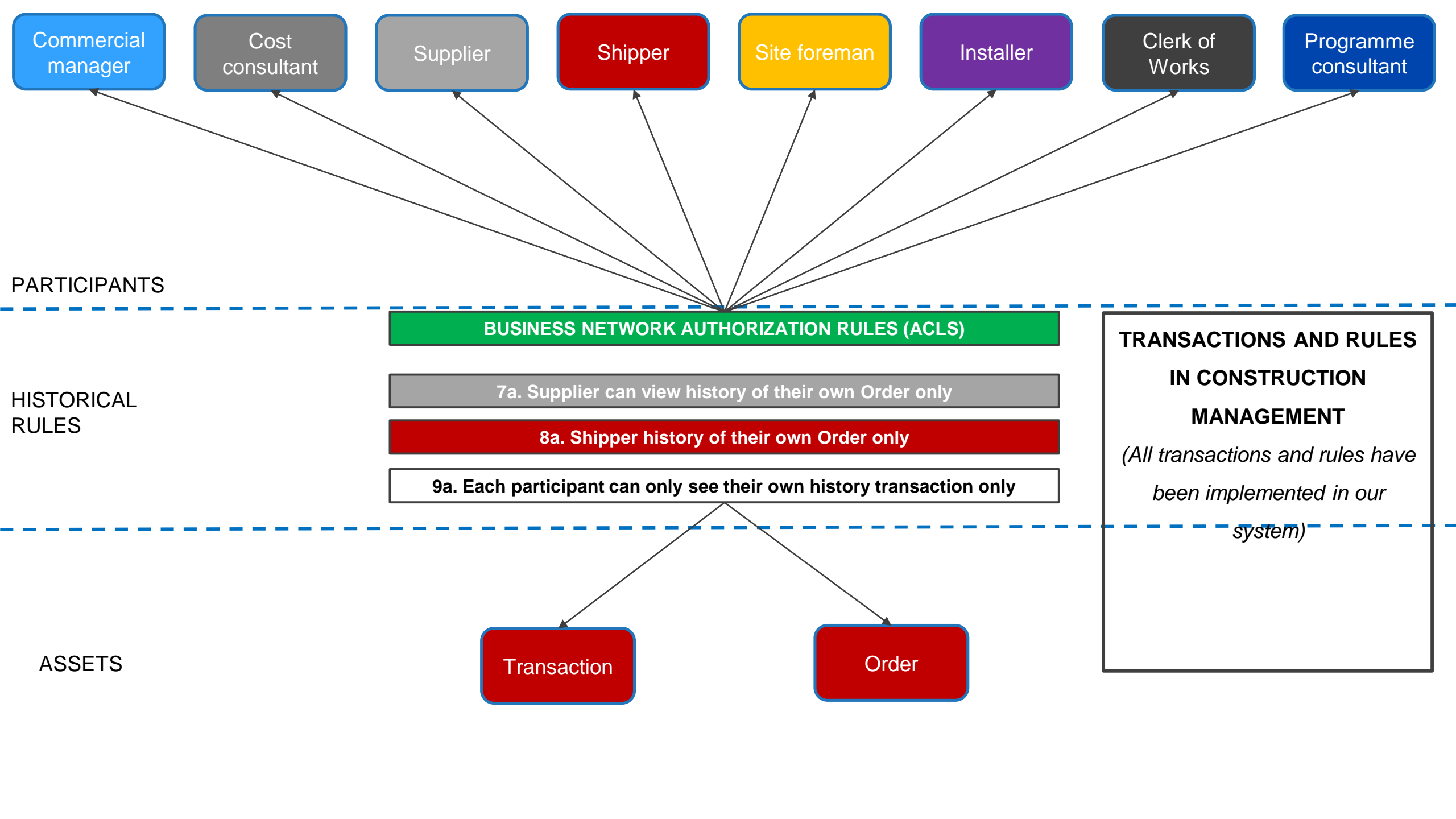
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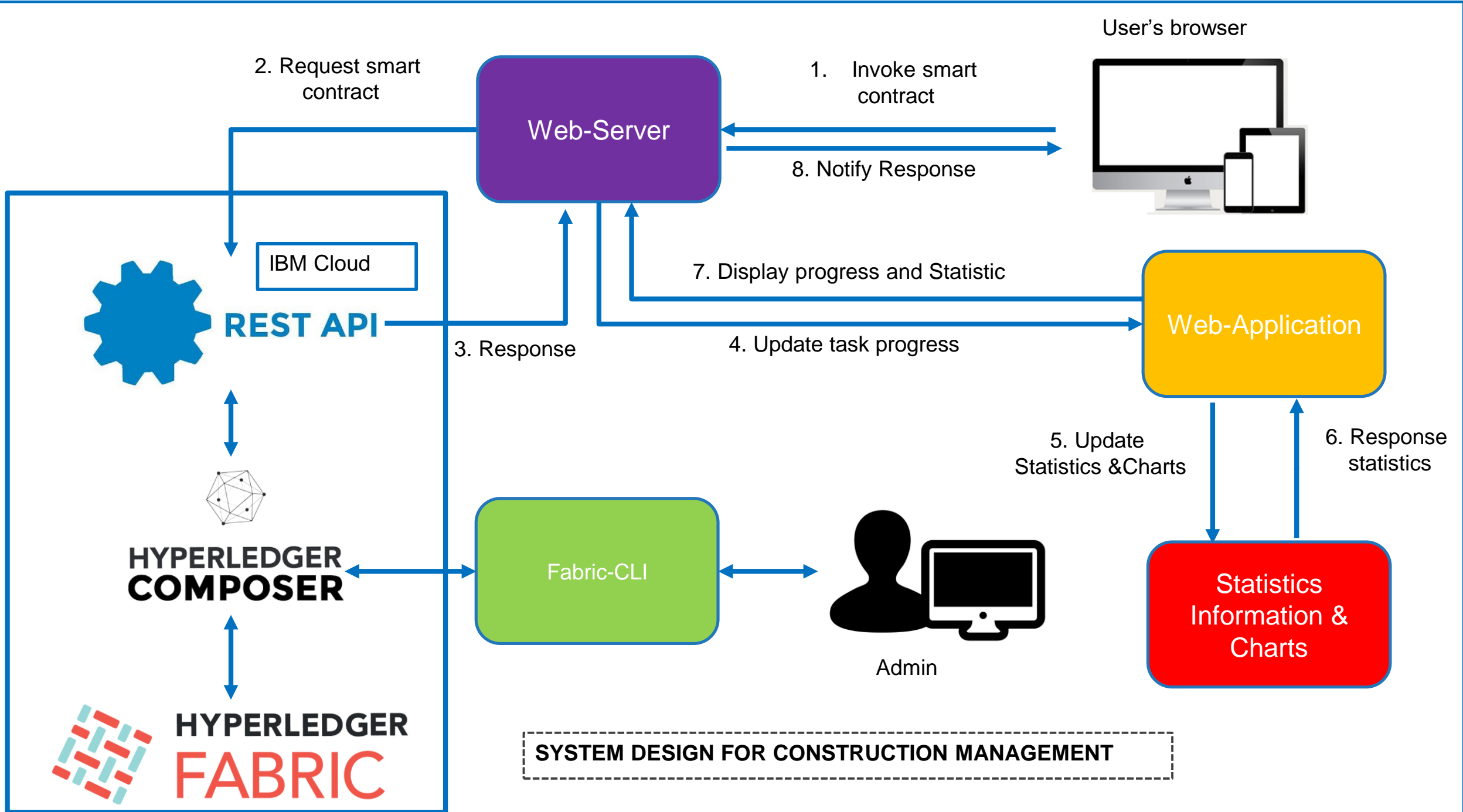


SEQUENCE DIAGRAM FOR CONSTRUCTION MANAGEMENT



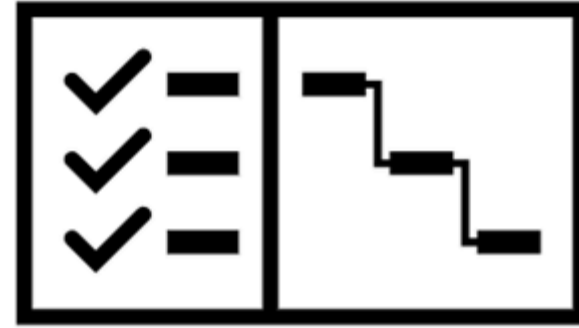




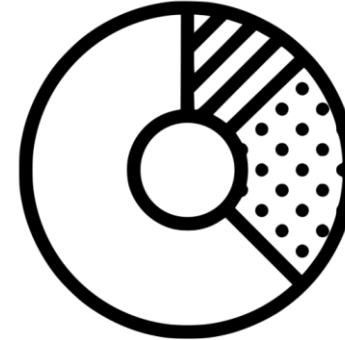


Statistics
Information &
Charts

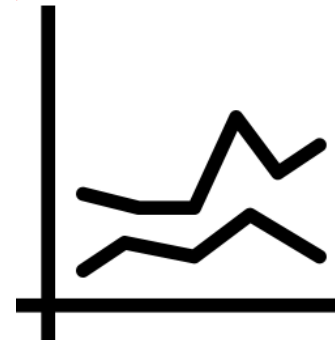
Controlling progress of project by
a Gantt chart



Manipulating budget of project by a
Donut chart



Reporting work rate of each participant
by a line chart

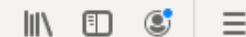


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› Project Deliverables:

- › Deliverable 1: a website for user
- › Deliverable 2: code is updated to a github
- › Deliverable 3: preparing a publication



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Commercial Manager List

Commercial Manager 1

Class	Commercial Manager Id	Company
org.example.basic.CommercialManager	JohnWick	IBM

Commercial Manager 2

Class	Commercial Manager Id	Company
org.example.basic.CommercialManager	Khai	IBM

Commercial Manager 3

Class	Commercial Manager Id	Company
org.example.basic.CommercialManager	LeoTungAnh	VNBlockchain

Commercial Manager 4

Class	Commercial Manager Id	Company
org.example.basic.CommercialManager	LeonardoDicarpo	Hollywood

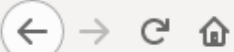
Commercial Manager 5

Class	Commercial Manager Id	Company
org.example.basic.CommercialManager	NguyenTungAnh	LinuxFoundation

Commercial Manager 6

Class	Commercial Manager Id	Company
org.example.basic.CommercialManager	TungAnh	VietNam

List of functions



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Buy List

Buy 1

Transaction Id	Commercial Manager	Supplier	Order	Time stamp
1d9f8ed44d29081a667b07b0f9c00098fa79e018f63b8400d14d44c2f303138c	TungAnh	Long	Order2	2019-09-14T04:27:45.771Z

Buy 2

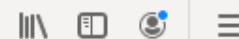
Transaction Id	Commercial Manager	Supplier	Order	Time stamp
315200b34b36629329bb6644764f23eb6b001d1a7e67f5168737ae833c5f3c47	TungAnh	Jack	Order2	2019-09-16T07:31:45.716Z

Buy 3

Transaction Id	Commercial Manager	Supplier	Order	Time stamp
b12f3cd68dcff0d3920b1ccfcb9ec165eaf6c88d5f2836d46c0f52f653af3c5d	TungAnh	Long	Order1	2019-09-12T03:46:20.465Z

Buy 4

Transaction Id	Commercial Manager	Supplier	Order	Time stamp
be85461a9f2b44be6db089324c6713f4482161d864e8d517c9e8ed08e724d2c6	TungAnh	Long	Order3	2019-09-19T15:00:23.837Z



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Deliver Shipping List

Deliver 1

Transaction Id	Shipper	Order	Time stamp
0ae4789494eb2a9716e86549cb3732be0e5874bd7ed6040771584ee6e6113fdb	Thanh	Order2	2019-09-14T04:30:37.769Z

Deliver 2

Transaction Id	Shipper	Order	Time stamp
159c1109ced34b797b2b28b72f8407061cc3e1b1069ff207fe38c94c8c3ec40d	Thanh	Order2	2019-09-16T07:26:37.128Z

Deliver 3

Transaction Id	Shipper	Order	Time stamp
31bab550674afa1db41d33be822e4675a1154afb2119ef5f058fb5b9a7ce516a	Thanh	Order1	2019-09-12T04:14:13.050Z

Deliver 4

Transaction Id	Shipper	Order	Time stamp
59bbdd1d4c50ca8f79db7e6ebe244579eb269aa4519b613aeeb973de897cac8c	Thanh	Order2	2019-09-16T07:33:41.388Z

Deliver 5

Transaction Id	Shipper	Order	Time stamp
da17e34464c6b1f97bd7469428d0c2bc858f16f72aab82169abd3ba2f9c7bb62	Thanh	Order3	2019-09-19T15:40:03.197Z

Deliver 6

Transaction Id	Shipper	Order	Time stamp
f3b2799092ca03a01795420c2c487a685719a586f94303daf03c681cf66e11ab	Thanh	Order3	2019-09-19T15:46:34.327Z



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Refund List

Refund Transaction 1

Transaction Id	Order	Bank Transaction Number	Time stamp
2f0d30c707f79bef94cccbb96c273c25b680d214fbee86346b1cec02fe56b780	Order3	Vietinbank#123456780000099	2019-09-20T02:44:01.092Z

Refund Transaction 2

Transaction Id	Order	Bank Transaction Number	Time stamp
f91777f97da5e3a8b941277bc571975275558a92b8a633e6038c7b28224c6ff4	Order2	Vietinbank#1234567811111	2019-09-14T04:48:55.137Z

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Request Shipping Back Order List

Test and Install Confirmation Transaction 1

Transaction Id	Order	Time stamp
344d8f9415bf6848c2aaeea9bf9871f5954f8ba21856044f43bce6746bca4f5c	Order3	2019-09-20T02:34:08.711Z

Test and Install Confirmation Transaction 2

Transaction Id	Order	Time stamp
4a655a056bcbfa1a92df82a1dad60f50dae150e92556ff3f291b9c85a6ad27ba	Order2	2019-09-16T07:25:17.847Z

Test and Install Confirmation Transaction 3

Transaction Id	Order	Time stamp
68774944f2ad8bde020941fdf65467d61d9b0867010bf74dbbaf3ba14ba7274c	Order2	2019-09-14T04:46:14.080Z



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Created Order List

Created Order 1

Transaction Id	Commercial Manager	Supplier	Order	Time stamp
22cf3632a2cc1341a61b32a84b57fa86eb212412b7ee930f067a9cb25088f31e	TungAnh	Jack	Order2	2019-09-16T07:29:09.605Z

Created Order 2

Transaction Id	Commercial Manager	Supplier	Order	Time stamp
8108c36b5f1a2eda6470780630811683541103e3412f355d65ca6e7bec068f9a	TungAnh	Long	Order1	2019-09-11T08:46:16.281Z

Created Order 3

Transaction Id	Commercial Manager	Supplier	Order	Time stamp
9a6fd919187a882bba026ee2bb8831f20f1e1dbb2375b4b60f63bc2808b1f0b1	TungAnh	Long	Order3	2019-09-19T14:47:41.074Z



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Create a Make Payment Transaction

Commercial Manager ID:

Supplier ID:

Order Number:

Bank Transaction Information Number:

Amount of money:

Submit

Create a Request Shipping Transaction

Site Fore Man ID:

Shipping Company Name:

Supplier ID:

Order Number:

Submit

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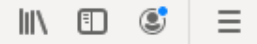
Create a Request Shipping Back Transaction

Site Fore Man ID:

Supplier ID:

Order Number:

Submit



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Create Shipper

Shipper ID:

Company:

Submit

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Create Site Fore Man

Site Fore Man ID:

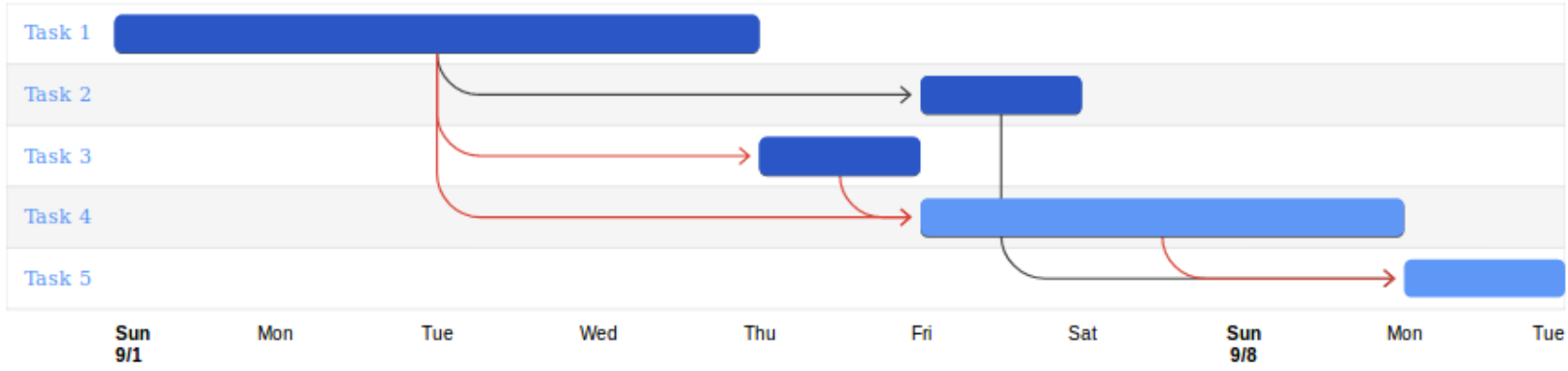
Company:

Submit

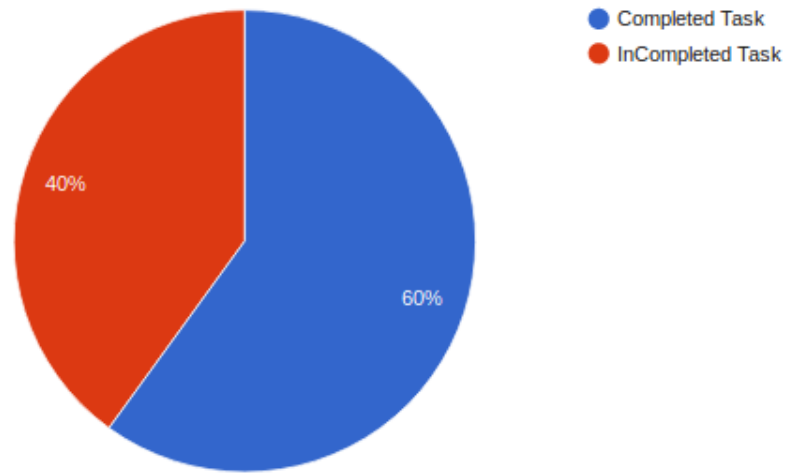
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Gantt Chart



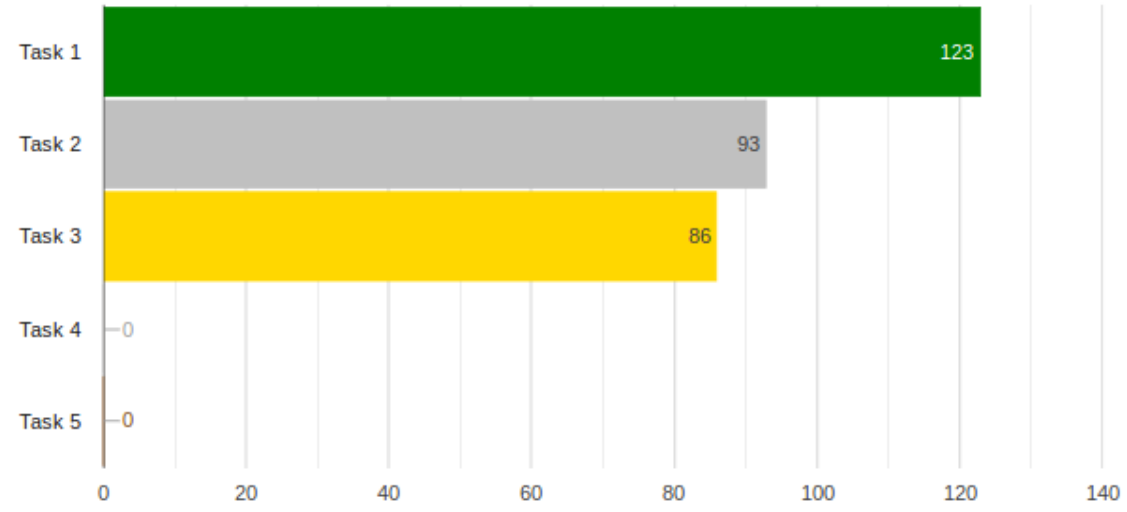
Project Progress



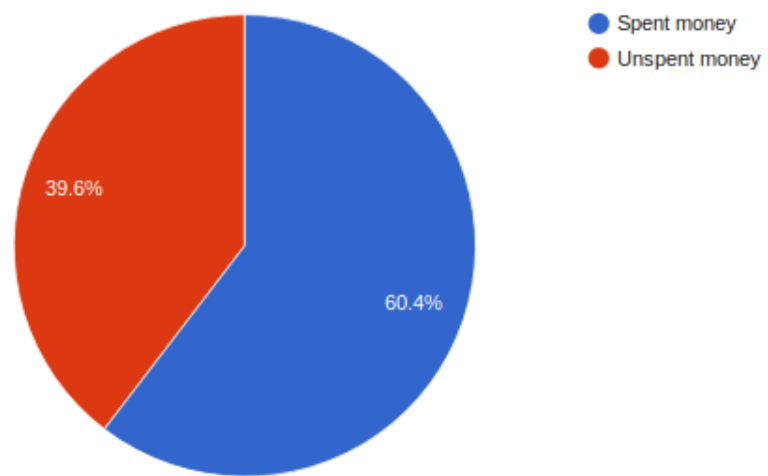
All clerks of work

- List of all create order transactions
- List of all buy transactions
- List of all request shipping transactions
- List of all delivering transactions
- List of all deliver transactions
- List of all deliver confirmation transactions
- List of all make payment transactions
- List of all test passed transactions
- List of all test failed transactions
- List of all installed transactions
- List of all not installed transactions
- List of all test and install confirmation transactions
- List of all request refund transactions
- List of all request shipping back order transactions
- List of all refund transactions
- List of all completed order transactions

- Create a Commercial Manager
- Create a Supplier
- Create a Shipper
- Create a Site Fore Man
- Create a Installer
- Create a Clerk Of Work
- Create an Order
- Create a Buy Transaction
- Create a Request Shipping Transaction
- Create a Delivering Transaction
- Create a Deliver Transaction
- Create a Deliver Confirmation Transaction
- Create a Make Payment Transaction
- Create a Test Passed Transaction
- Create a Test Failed Transaction
- Create a Not Installed Transaction
- Create a Installed Transaction
- Create a Test and Install Confirmation Transaction
- Create a Request Refund Transaction
- Create a Request Shipping Back Transaction
- Create a Refund Transaction
- Create a Order Completed Transaction



Total Budget: 500S



Blockchain for construction management

- › **Recommendations for future work:**
- › Project is only implemented in localhost for testing functions of blockchain system because of limited budget and computer power.
- › If project is funded for an free account of cloud and computers, blockchain system can be deployed on cloud by using docker and test in reality conditions.
- › With detail documents and source code, it can instruct developer how to convert business needs to algorithms and implement them to chaincode, generate APIs for exchanging data between user and blockchain system, create user interface, make statistics and apply machine learning algorithm for data in transactions. Furthermore, system architecture provides the manner to combine blockchain, statistics and machine learning based on smart contract which would be helpful for Hyperledger to develop extend modules.

Thanks You For Listening!

