UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION

JULY 2025 SEMESTER SESSION (7-WEEK)

SUBJECT CODE	:	**LOM10903**
SUBJECT TITLE	:	**MARITIME LOGISTICS**
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	**MASTER OF MARITIME OPERATIONS AND MANAGEMENT**
TIME / DURATION	:	**9.00 AM - 12.00 PM** **(3 HOURS)**
DATE	:	**17 SEPTEMBER 2025**

INSTRUCTIONS TO CANDIDATES

1. Please read **CAREFULLY** the instructions given in the question paper.

2. This question paper has information printed on both sides of the paper.

3. This question paper consists of **TWO (2)** sections; Section A and Section B.

4. Answer **ALL** question in Section A. For Section B, answer **THREE (3)** questions with at least ONE (1) question from question 4 or question 5.

5. Please write your answers on this answer booklet provided.

6. Answer **ALL** questions in English language **ONLY**.

THERE ARE 9 PAGES OF QUESTIONS, EXCLUDING THIS COVER PAGE.

SECTION A (Total: 40 marks)

INSTRUCTION: Read the case study and answer ALL questions.
Please use the objective answer sheet provided.

Question 1

BLOCKCHAIN FOR GLOBAL MARITIME LOGISTICS

Introduction

Blockchain, with a relatively short history has garnered large interest, though most noticeably from general public and specifically for its use in enabling bitcoin and other crypto-currencies. Although not as visible or hyped as the digital currencies, many private enterprises, consortiums, and government agencies have been busy conducting research and development to harness the technology and using its fundamental tenets for reengineering their business processes and introducing new business models. The objective of this paper is to examine the feasibility of using a blockchain for maritime containerized logistics. As part of this objective, a Web based proof-of-concept prototype application was developed to demonstrate potential functionality of such a blockchain. The paper also includes detailed description and a walk-through of the prototype.

According to IBM (2018), "blockchain is a shared immutable ledger for recording the history of transactions". This concept behind the blockchain technology has a tremendous potential for creating cost-effective and efficient business networks for trading anything of value between and among interested traders without requiring an intermediary party or central authority. Although it is commonly described as a new and innovative technology, blockchain is actually not a single technology. Implementing a blockchain entails a new way of cobbling together a number of existing tried and tested technologies, methods, frameworks, and protocols into a permissioned or permissionless network for information sharing and transaction processing. Some of the important techniques and technologies that have come together in this ensemble include public and private communication networks (such as peer-to-peer networks), distributed databases, state machines and logs replication, cryptography, consensus algorithms, concurrency control, and more (Olson et al., 2018). Cryptographic signatures are used to ensure security and correctness of transactions. Together with distributed consensus among trading parties and the non-repudiation property of blockchain transactions once the consensus is reached, blockchain ensures consistency.

As an example of the growing interest by the US and other governments, in 2016 the US Department of Health and Human Services sought research proposals to examine potential use of the blockchain technology in "patient centered outcomes research (PCOR), precision medicine, and other health care delivery needs, as well as provide recommendations for blockchain's implementation." (USDHHS, 2016). Other governmental agencies including the US Department of Homeland Security and the Department of Defense recently awarded research contracts to explore possible use of the blockchain technology. The Defense Advanced Research Projects Agency (DARPA) sought to develop a secure messaging system using a distributed ledger for encrypted communications, and NATO announced a technology innovation contest in 2016 to explore the use of blockchain in battlefield applications and other related tasks (Coindesk, 2016). Sweden's land mapping and registration authority is planning to test its blockchain based real estate system to conduct property sale in 2018. It is currently seeking volunteers to buy or sell property using this system (Anand, 2018).

Even more enthusiastically than governmental agencies, major corporations in the US and around the world are investing in research and development of blockchain-based systems to augment existing ones, and offer new products and services. Corporate spending on blockchain technology is estimated to exceed 2 billion dollars in 2018 from under one billion in 2017 (Nash, 2018). Walmart recently tested a blockchain based produce tracking application using which an employee can scan a single piece of fruit such as a mango in a Walmart store in the US and know the farm where it came from. More than one million items on sale or sold in Walmart stores are said to be currently on the blockchain (Mims, 2018). Last year, British Airways tested a blockchain based flight information system to ensure data consistency to prevent displaying inconsistent information at different locations such as airline gates, airport monitors, and the company's websites (Nash, 2018). A major global shipping company, Maersk, is said to be using the blockchain technology developed by IBM to track sea-borne containers and expedite customs clearance (Mims, 2018). One of the "Big Four" accounting firms, PricewaterhouseCoopers (PwC), plans to offer an auditing application to validate block-chain based transactional systems. It is currently testing an application that is meant to audit and verify its clients' blockchain based systems to ensure that they are compliant of the legal and regulatory requirements (Rapoport, 2018). The PwC application has reportedly been tested by a number of its clients including one major stock exchange that needs to verify its blockchain-based payment process.

In summary, one of the core features of the blockchain technology is disintermediation: blockchain technology promises to confer the aforementioned capabilities and benefits without requiring any central authority or intermediaries. Another property of interest of the blockchain based business models is their maintenance of distributed and immutable sets of records of

asset ownership, transfer, and transactions. Inherent in disintermediation and distributed record keeping, however, are potential challenges as well. For example, lack of a central authority to administer and audit transactions in a number of cryptocurrency offerings may have facilitated fraud and rendered them vulnerable to abuse and crime (Ramey, 2018). Also, although it is extremely difficult to make unauthorized modifications to the distributed blockchain data, it is certainly not impossible to do so. It is therefore prudent to better understand and carefully weigh potential benefits and challenges for each blockchain use case before implementing this technology.

The next section contains detailed description of a specific supply chain use case with focus on maritime containerized logistics. The section that follows the next section describes a simplified scenario of this use case with the help of the proof-of-concept application prototype. The last section concludes the paper with a summary, limitations of the study, and possible directions for further research.

Global Containerized Logistics and The Case For Blockchain

Global container shipping is an essential part of the global trade. An estimated $4 trillion worth of manufactured goods, heavy machinery, raw materials, food, and consumer goods are moved around the world in shipping containers (Costas and Tsuneoka, 2018).

Containerized shipping supply chain is highly fragmented. Besides sea-borne transportation, the shipping supply chain has numerous players at each step of the shipping process: domestic transportation – typically by road, rail, and some air modes; multiple freight forwarders; warehouse and docks owners and operators; port authorities, often with differing policies and political jurisdictions. Figures 1(a) and 1(b) below show participants in a typical containerized shipping supply chain.
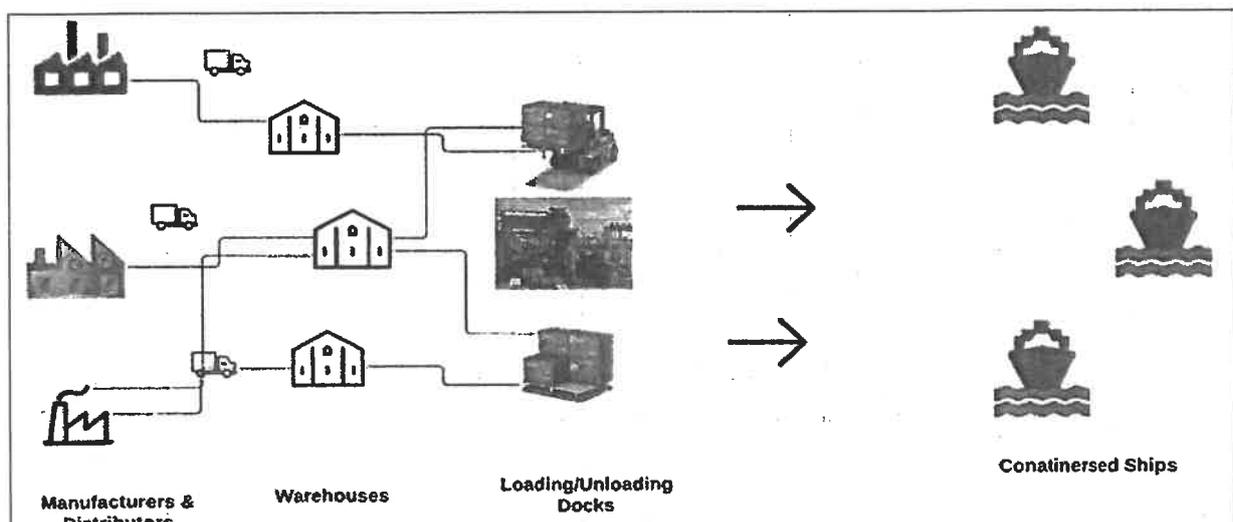

Manufacturers & Distributors   Warehouses   Loading/Unloading Docks   Conatinersed Ships

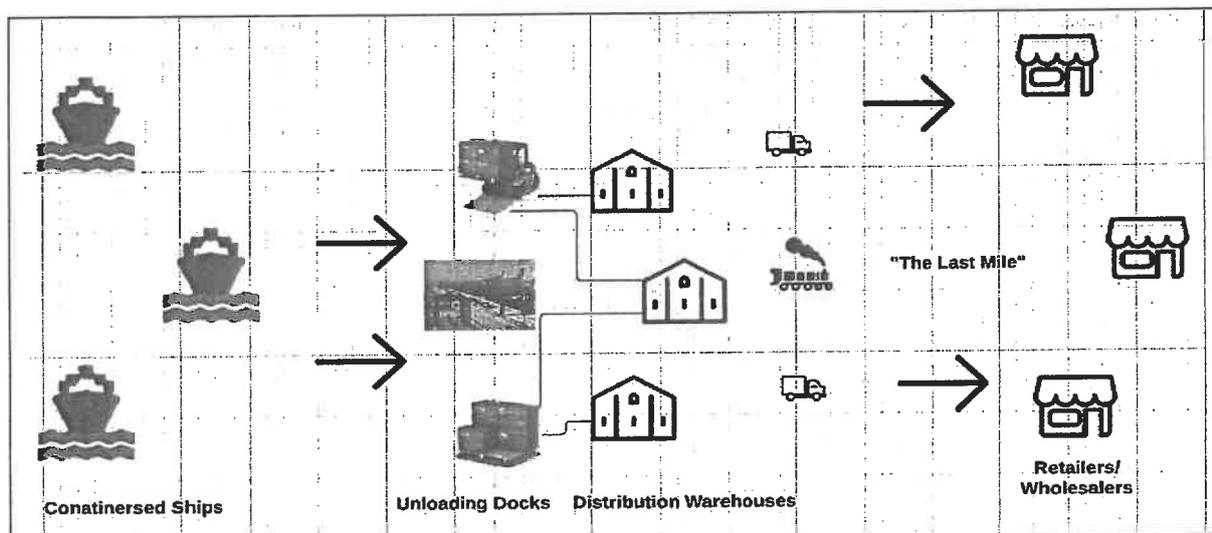**Figure 1(a).** Outbound Segment of Containerized Logistics

Figure 1(b). Inbound Segment of Containerized Logistics

Information systems and operating procedures of various participants in the global shipping supply chain are often different and incompatible; many of them have business processes that are paper-based, even today (Economist, 2018). This adds to the total cost and delays for importers, exporters, and the shipping companies. Due to high costs and low profit margins, a number of smaller containerized shipping companies have either abandoned their business, consolidated, or were bought by larger ones during the last decade. A conspicuous display of this trend was the 2016 failure of the world's eighth largest shipping company, South Korea's Hanjin Shipping (Economist, 2018).

Motivations for Adopting the Blockchain

There are compelling reasons for policy makers, governments, and shipping companies around the world to modernize, digitize, and integrate their systems and infrastructure to facilitate global trade, including maritime trade. And the blockchain technology has the potential to be an essential part of such modernization as discussed below.

Global Shipping –a Strategic Asset: For many countries, especially major world economies, global commercial shipping is increasingly viewed as an important strategic asset (Costas and Tsuneoka, 2018). China's recent $900 billion "Belt and Road" initiative is a vivid demonstration of this view. Increasing adoption and use of blockchain technology by their trading partners worldwide would make it necessary for many governments and importers and exporters to participate in these initiatives or risk losing their trade and competitiveness.

Time and Cost Savings: A large proportion of the around $3 trillion non-domestic cargo shipping is earned by freight forwarding companies that deal with customs clearance, transfers

between sea and land, and procedural and logistics matters. Besides bureaucratic delays, outdated procedures and a mix of digital and paper-based forms add to the inefficiencies in global supply chains. To address this problem, a number of shipping companies such as Amazon.com and Deutsche Post/DHL are beginning to vertically integrate parts of their supply chains with their operations by having in-house freight forwarding (Economist, 2018) and thereby effectively removing intermediaries for time and cost savings. Core features of the blockchain such as its support for disintermediation and making consistent, real-time information available online, can help save a great deal in time and money.

Need for Transparency: Since many freight forwarders typically charge by a percentage of the total cost, they have the incentive to increase rather than reduce total costs. A blockchain can help eliminate unnecessary steps in the process and shed light on the entities and steps that may be responsible for unnecessary costs and delays. For example, a number of major companies including AT&T, Kellogg, Bayer, and Nestle are participating in blockchain initiatives to gain visibility into their online advertising campaigns to know exactly how many real people (and not robots) are actually viewing their ads and how much of their ads budgets are spent on ad agencies and other intermediaries vs. the online publishers (O'Reilly, 2018). Doing so would help these companies better negotiate with the intermediaries and reduce their costs.

Blockchain's Synergistic Relationship with Other Technologies

As noted earlier in this paper, blockchain is not a single technology but rather it benefits from a number of other enterprise technologies and practices including distributed database, encryption, peer-to-peer networks, and more. With its lineage as a technology ensemble and its enterprise-grade features supporting decentralized collaboration, it will no doubt continue to benefit from many current and emerging technologies. Figure 2 shows a few of the ways currently popular technologies can help augment blockchain's functionality.
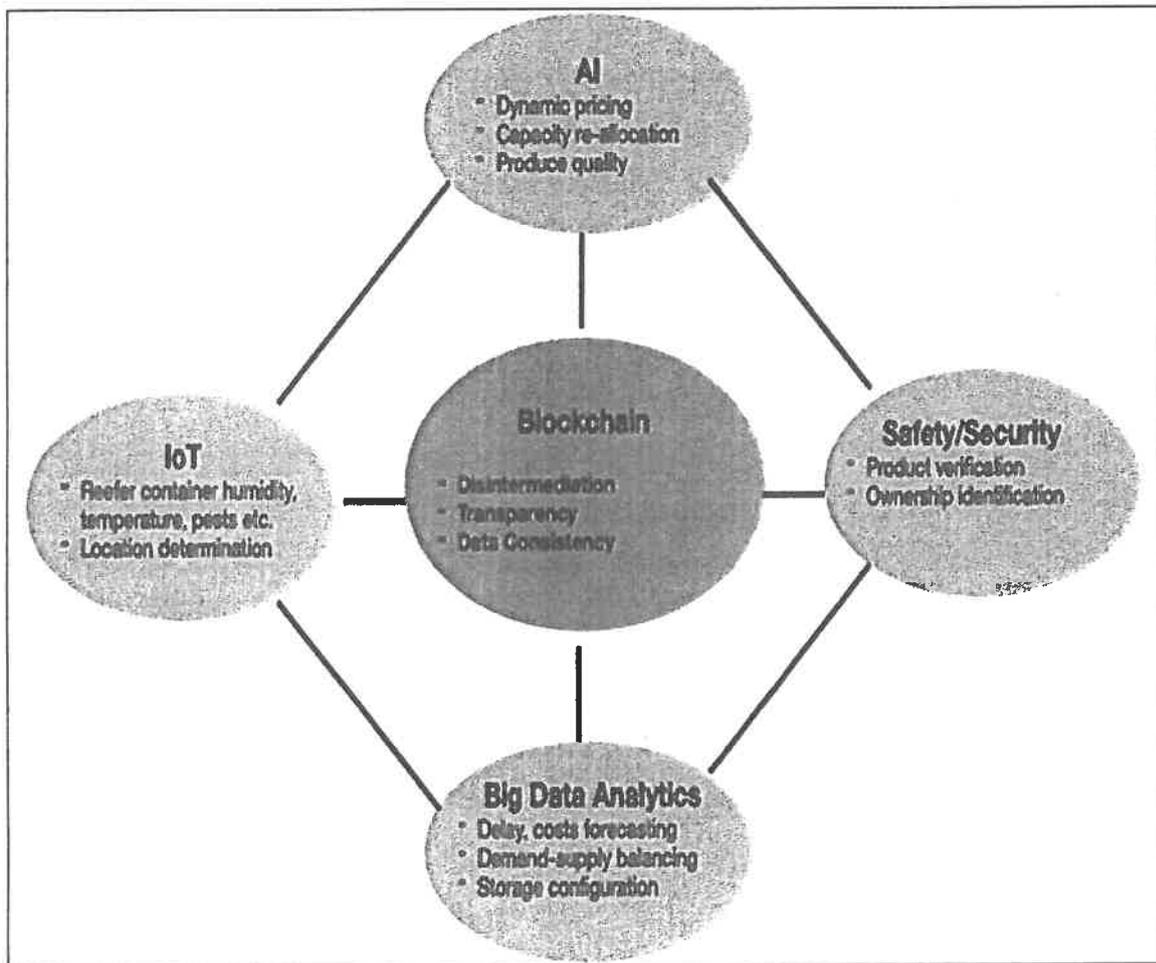
Figure 2. Blockchain's Synergy with Other Technologies

Conclusion

The field of global trade and logistics has a broad scope that requires multi-lateral coordination and negotiation among several organizations, governments, and regulatory agencies for successful execution. One limitation of this study is that it offers a high-level view of this field's technological and business landscape. In-depth research into its component areas is necessary to bring the concepts offered in this study to fruitation in the form of a fully functional blockchain.

Earlier in this paper four technological fields were identified as excellent candidates for synergistic relationship with the blockchain technology. As depicted in Figure 2, these areas include artificial intelligence (AI), the Internet of Things (IoT), cyber security, and big data analytics. Further research may examine how these technologies may be incorporated in the blockchain and the resulting data and insights into decision support. As an example of integrating IoT into a blockchain network, Hyperledger Sawtooth module called Supply Chain may be used. This module helps track refrigerated containers (known as "reefers") through

the supply chain and collect telemetry data such as temperature and humidity. The main reefer trade routes are from Southern hemisphere (South America, South Africa, Australia, New Zealand) to Northern hemisphere countries and this trade is growing at the rate of 5- 6% annually (Paris, 2018). Refrigerated containers can keep food fresh for about a month and are often used to ship fruit, seafood, and other perishable goods. Such telemetry data could be of great value in transportation, warehousing, pricing, and product sourcing decisions.

(a)   Based on the statement, evaluate the potential of blockchain based maritime logistics in addressing inefficiencies in containerized shipping supply chains, focusing on structural, procedural, and technological dimensions.

(10 marks)

(b)   Based on the statement, explain a comprehensive blockchain adoption strategy for a mid-sized shipping company seeking to minimize intermediary dependency while maintaining regulatory compliance in multiple jurisdictions.

(10 marks)

Question 2

(a)   Refer to the statement on question 1, assess an integrated framework combining blockchain with emerging technologies (AI, IoT, Big Data, Cybersecurity) to enhance transparency, traceability, and decision-making in global maritime logistics.

(10 marks)

(b)   Refer to the statement on question 1, analyze the limitations of the proof-of-concept Hyperledger Sawtooth application with respect to scalability, interoperability, and stakeholder adoption challenges.

(10 marks)

SECTION B (Total: 60 marks)

INSTRUCTION: Answer only THREE (3) questions.
Please use the answer booklet provided.

Question 3

(a)   Evaluate the influence of fixed and variable transportation costs on strategic maritime
        shipping decisions within fluctuating global trade environments.

                                                                                (10 marks)

(b)   Interpret a cost-output optimization model for maritime transport operations that
        addresses carrier capacity constraints alongside service reliability.

                                                                                (10 marks)

Question 4

(a)   Measure a comprehensive routing model for intermodal maritime logistics that
        minimises congestion effects at terminal facilities while sustaining delivery
        performance.

                                                                                (10 marks)

(b)   Justify the sustainability implications of larger vessel deployment in maritime logistics
        considering economic, environmental, and operational perspectives.

                                                                                (10 marks)

Question 5

(a)   Assess an integrated distribution strategy for perishable goods within maritime supply
        chains applying probability distribution concepts for demand forecasting.

                                                                                (10 marks)

(b)   Explain an adaptive shipping strategy that responds to evolving international trade
        patterns while maintaining resilience against port capacity limitations.

                                                                                (10 marks)

Question 6

(a)　Explain the role of current e-commerce trends in reshaping maritime logistics operations with emphasis on last-mile delivery integration.

(10 marks)

(b)　Determine a framework for resolving multi-disciplinary port industry problems through maritime logistics principles with measurable performance indicators.

(10 marks)

END OF EXAMINATION PAPER