CHAPTER 1
INTRODUCTION

1.1 Background

Indonesia is an archipelagic country with over 17,000 islands, making maritime transportation crucial. This underscores the importance of ports, which connect remote regions, facilitate trade, support tourism, and create jobs. Efficient port infrastructure also enhances national security and logistics operations. Future investments are directed towards this. Jayapura Port, as the main gateway in the city of Jayapura and its vicinity, is equipped with 6 cranes to facilitate the movement of goods between the port and ships[1].

In total, Jayapura Port features two Port Cranes for loading and unloading goods onto ships, as well as four Gantry and Port Cranes to manage the layout of containers within the port area. All cranes operate continuously 24 hours a day. As a result, 6 workers are required daily, working in 3 rotating shifts, to operate these six cranes, totaling 18 crane operators needed. It needed at least 27 operators a month with maximum 160 work hours.

High number of manpower has given rise to the idea of transitioning crane operations to remote control using wireless technology for added convenience. With crane controllers placed on the cranes themselves and operators controlling them from dedicated rooms, the number of operators can be reduced, cutting operational costs and work-related risks. The use of remote technology also enhances safety, as operators do not need to be atop high and hot cranes. Although challenges like network reliability and operator training must be addressed, implementing this technology can significantly improve the operational efficiency and productivity of Jayapura Port.

In recent years, 5G has emerged as one of the most anticipated technologies for internet users. The primary reason for this anticipation is the speed offered by 5G, which can reach up to 100 times the speed of 4G. Among various countries, Indonesia has been relatively slow in commercializing 5G services. Indonesia only began releasing 5G services in July 2021, whereas by September 2020, more than 60 other operators worldwide had already implemented and commercialized 5G, according to a GSMA report[2].

Following the implementation of 5G Smart Mining, several potential use cases are being explored in Indonesia, one of which is Smart Port or the implementation of 5G in ports after the Smart Mining implementation in Tembagapura, Papua. Ports in Indonesia hold significant

importance in the livelihood of the population, given Indonesia's topography consisting of over 17,000 islands, making maritime transportation crucial, especially for inter-island logistics. The implementation of Smart Port with 5G technology is believed to enhance efficiency by up to 90% through its low latency, high bandwidth, and reliability[3].

In the implementation of the smart port, there are several interesting use cases to be implemented. These include centralized control of Gantry and Port Cranes. Gantry Cranes are large container lifting devices, typically operated by one person each. However, with 5G Smart Port, all Gantry Cranes can be operated by a single person [4].

In previous research, an analysis was conducted on the implementation of 5G for general cellular communication needs without specific use cases. This time, the focus will be on the implementation of 5G with a case study of Smart Port implementation, along with an analysis of the implementation of this case study.

1.2 Problem Identification

Based on the background outlined, several research questions related to this study can be formulated as follows:

1. The number of manpower for crane operators quite big. Because each Crane needs 3 manpower everyday. Because Jayapura Port has 6 Cranes, so it will need minimum 27 Crane Operators to run the Cranes full 24 Hours a Day.
2. High risks for Crane operators working at High place and at any weather on the Crane. This will gained the operator fatigue especially in Hot and Rainy Weather.
3. From the proposed solution, need a feasibility for the System Implementation.

1.3 Objective

The aim of the research based on background to simulate the possibility of Remote Control System for Cranes at Jayapura Port. After the simulation using Cisco Packet Tracer and Forsk Atoll done, needed Techno-economic Analysis on economic aspect to make sure the implementation is possible for company benefit, especially for Sensitivity and Cost-benefit aspect.

1.4 Hypothesis

The main problem faced by Port is the efficiency of day to day operation at the Port. High Cost of manpower to operate Port Crane and Gantry Crane because Crane Operators need special qualification. Another problem is the risks for the Crane Operator because they do their job at

high place, also works at any season and weather need more energy when the weather getting worse.

The implementation of remote control crane could solved the problems, because the system make it possible for one operator to control more than one Cranes. The remote control crane also possible to control the crane from operator room so the risks for operator can be reduced.

Based on various reference, a hypothesis can be set that high cost of Crane Operators and the risks associated with the Operators Job could solved by Remote Control Crane Operators. The hypothesis defined as follows:

1. The possibility of Remote Control Crane implementation need simulation from network parameters using Cisco Packet Tracer, and then area coverage regarding the implementation done using Forsk Atoll.
2. This implementation need economic calculations start from Cost Structure, Feasibility Analysis, Sensitivity Analysis, and Cost-benefit analysis. To know is it good to implement or not based on economic side.

1.5 Scope of Work

Here are the Problem Scope and Limitations of this research:

1. Creating simulations of 5G network implementation with the use case of Smart Port for Jayapura Port.
2. Simulated use cases include Centralized Gantry Crane and Port Crane Control.
3. The simulated 5G frequency is 2300 MHz.
4. Simulations are conducted within the Jayapura Port area.
5. Simulations are developed using the software tools Forks Atoll and Cisco Packet Tracer.
6. The Techno-Economic Analysis encompasses parameters such as CAPEX, OPEX, NPV, Payback Period, Profitability Index, Sensitivity and Cost-Benefit Analysis.

1.6 Methodology

In this research, the process start from Information Collection and Information Analysis. Next process is modeling the system and repeat it until the system fit the requirement. Last the techno-economic analysis to prove the system feasible for business requirement. Here is the following methodology Flowchart:

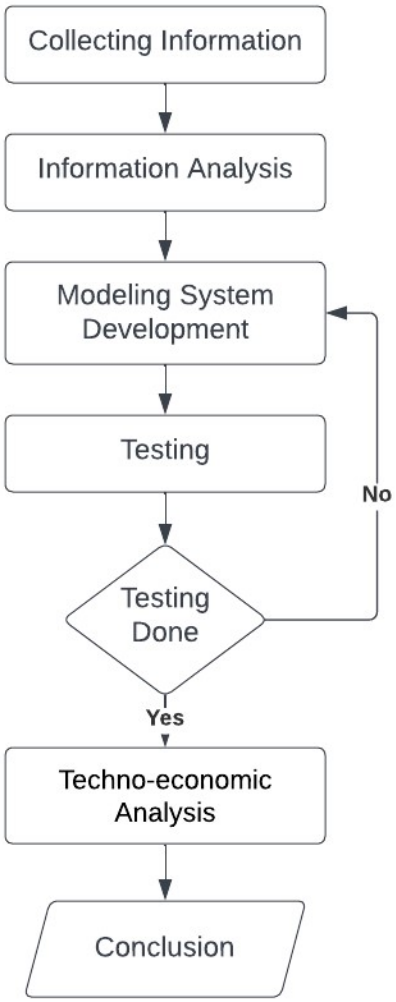

Figure 1.1 Methodology

1.7 Research Method

1. Literature Review

In this phase, a search for references is conducted, including academic journals, government reports, research papers, and analyses related to 5G Technology, Smart Port Use Cases, 2300 MHz Frequency, and Techno-Economic aspects.

2. Data Collection

Data collection involves gathering information about 5G Technology, Smart Port Use Cases, 2300 MHz Frequency, Techno-Economic aspects, and research-related elements such as implementation requirements and network service design.

3. Simulation and Design

The design is carried out using Forks Atoll and Cisco Packet Tracer applications to obtain coverage estimations and network quality analyses.

4. Mathematical Calculations

Calculations are performed using stand-alone methods, CAPEX, OPEX, NPV, Payback Period, Profitability Index, Sensitivity and Cost-Benefit Analysis.