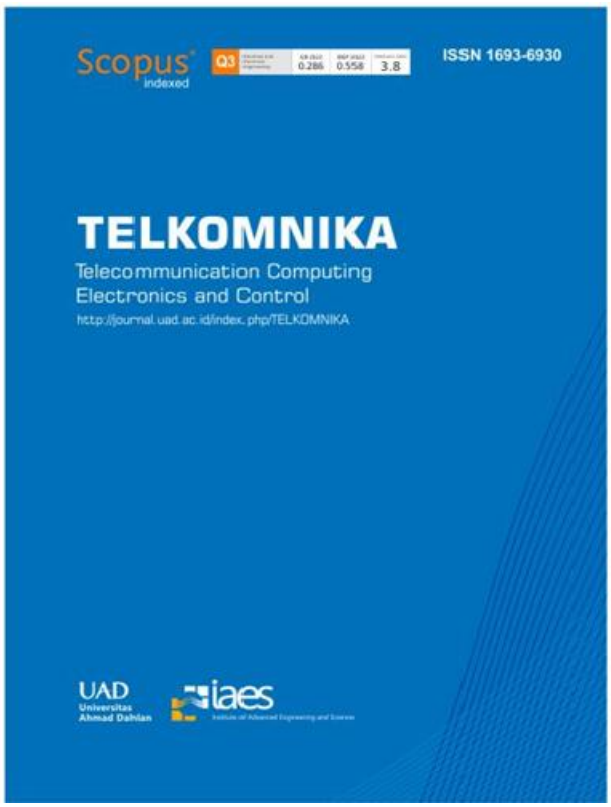

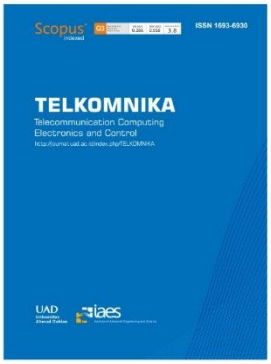

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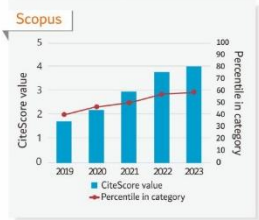

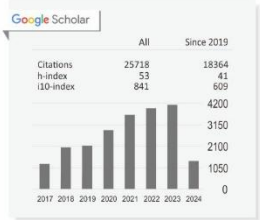

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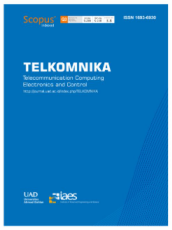

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The Causal Loop Diagram (CLD) Model of Traceability System Rental Equipment in Oil and Gas Supporting Companies

Asep Endih Nurhidayat[1] , Rina Fitriana[2]
[1'2]Department of Industrial Engineering, Industrial Technology Faculty, Universitas Trisakti, Jakarta, Indonesia

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ABSTRACT

In carrying out the equipment rental business process in oil and gas supporting companies, there is often an imbalance in terms of efficiency which causes customer complaints, decreased Request For Quotation, high handling and breakdown costs. So this has a direct impact on decreasing sales and profits. The aim of this research is to find out what factors influence the system so that it can improve the efficiency of running business processes. In problem solving, the first thing to do is identify the variables related to the system, design a rich picture diagram to briefly describe the system, then create an influence diagram to see the relationships that occur in the variables, then create a Causal Loop Diagram modeling (CLD) produces dynamic factors related to cause and effect problems that influence the traceability system implemented in the Company. The results obtained are that to increase Request For Quotation you must pay attention to the level of efficiency, customer satisfaction and rental prices. High rental prices are influenced by maintenance costs and high equipment prices which also have an impact on decreasing efficiency and customer satisfaction. If rental prices are low it will increase efficiency and customer satisfaction which has a direct effect on profits and sales.

Corresponding Author:

Asep Endih Nurhidayat
Industrial Engineering Doctoral Program, Trisakti University, Jakarta, Indonesia
Email: annoerhidayat@gmail.com

1. INTRODUCTION

The Industrial Revolution and globalization provide challenges as well as opportunities for companies operating in it. To be able to survive and win the competition, companies need to make plans by turning existing challenges into opportunities for business [1]. All companies engaged in industrial activities will compete with each other to get customers to sell the products they produce. One of them is the oil and gas industry, where this industry is one of the largest contributors of foreign exchange to the country and its scope is very broad, from upstream to downstream activities. To increase customer satisfaction in the OIL and Gas industry, what must be considered is maintaining service quality[2].

Quality is a dynamic condition related to products, people/labor, processes and tasks, and the environment that meets or exceeds customer or consumer expectations. [3]. From this understanding, the meaning of service quality can be concluded that quality is relative because it is dynamic depending on the satisfaction of each service user. Service quality is determined by two things: expected service and perceived service. Expected service and perceived service are determined by the dimension of service quality [4] consisting of :

1. Tangibles: Appearance of physical facilities, equipment, personnel, and communication materials

2. Reliability: The ability to perform promised services reliably and accurately
3. Responsiveness: Willingness to help customers and fast service
4. Assurance: employee knowledge and courtesy and their ability to convey trust and confidence
5. Empathy: The company provides individual attention and attention to its customers.

The development of Outsourcing strategic management in the OIL and Gas industry is increasingly receiving attention because of its potential and has recently become one of the most popular alternatives [5]. This strategy is to solve several problems in the Oil and Gas industry, which has developed in scope, from resource sharing to the need for advanced technology [6]. The implementation of outsourcing by oil and gas companies was previously considered critical and strategic and very risky if handed over to external companies (work partners), but is now made easier by the many companies or supporting services available on the market .

Oil and Gas (Oil and Gas) supporting services companies operate in business activities that provide upstream and downstream oil and gas services. These supporting service activities consist of oil and gas construction and non-oil and gas construction services. The oil and gas construction services business is a service for handling building or construction work or other physical forms that aim to support oil and gas business activities. Oil and gas construction services consist of construction planning services including design and engineering (design engineering), construction implementation (EPC, installation and commissioning) and construction supervision. Meanwhile, non-construction oil and gas services are work services other than construction services to support oil and gas businesses such as seismic and non-seismic surveys, demolition, inspection, underwater work and other services.

In oil and gas construction work, one thing that is often needed is the availability of equipment to carry out construction or maintenance projects at the project site. Usually, oil and gas companies for this equipment use equipment owned by contractor service companies or in other words, oil and gas companies rent equipment to contractor service companies. By renting equipment, there are many obstacles faced, both from the equipment rental company and also from the renting company. Savin et al. in [7] provides an overview of the rental company's business model "the company invests in equipment that has potential demand, and a flow of customers subscribes to the company, renting out its equipment. After each rental, the equipment is returned to the company, and the rental duration is usually much shorter than the life of the equipment, so each unit can be used repeatedly." It can be seen that running an equipment rental business has great potential and opportunities, but it cannot be denied that the initial investment is expensive and requires a large amount of capital.

In the business processes carried out by oil and gas supporting companies, problems are usually found, including frequent damage to equipment while in the field, equipment specifications that do not match what consumers need and there are even loss of equipment. These problems result in the company's performance decreasing which results in complaints from customers and increased handling costs. Apart from that, there is often an imbalance in terms of efficiency which causes customer complaints, decreased Request For Quotation, high handling costs and breakdowns. So this has a direct impact on decreasing sales and profits.

To reduce various problems in equipment rental activities, the use of information technology in the form of implementing a traceability system is a very important tool for the Company in carrying out the equipment tracking process both before the rental is carried out, during the rental process and until completion of the rental. The treasury system also aims to increase security and effectiveness in the equipment rental process. A good traceability system is able to minimize poor and unsafe material quality in the supply chain [8]. Sistem *Traceability* sangat bergantung pada rekaman informasi. Diperlukan mekanisme yang kuat untuk memfasilitasi pengumpulan dan otentikasi informasi apa pun, agar dapat diperbarui dan dibagikan melalui rantai pasokan [9].

From this research it is hoped that it can answer; What variables are related to the system? What are the relationships between variables that are cause and effect? And to increase the level of efficiency, what main factors must be considered? To analyze problems that occur, it is done using systems thinking, consisting of three kinds of things: elements (in this case characteristics), interconnections (how these characteristics relate to and/or provide feedback to each other), and function or purpose. In particular, the most invisible part of a system, namely its function or purpose, is often the most crucial part of determining system behavior. While not all systems have clear goals or objectives, systems thinking does [10]. Systems Thinking is equipped with tools to understand the basics and principles of dynamic decision making [11], while the methodology in this case is a set of modeling and learning technology used in Systems Thinking [12]. Modeling will be used to understand the structure of a system, and show how changes in one area will impact the entire system and all its constituents at a certain time. [13].

To find out environmental factors that are variables that are value-free but have certain behavioral patterns, that is, if a variable changes, it will influence other variables according to the behavioral pattern. [14]. Causal loop diagrams highlight the core elements of a system, and the system behavior that emerges from their

interactions [15]. Visualize factors, relationships and how they influence each other in a system. The relationship can be positive – when A increases, B also increases, or when A decreases, B also decreases – and is illustrated with a blue arrow and a '+' symbol; or negative – when A increases, B decreases, or when A decreases, B increases– and is illustrated with a red arrow and a '-' symbol [16], [17]. Factors and relationships form a series of close causal relationships, known as 'feedback loops'. [18]. The aim of this research is to determine the impact of dynamic factors related to cause and effect problems that influence the traceability system implemented in oil and gas supporting companies using the Causal Loop Diagram (CLD) model.

2. METHOD

This research uses a descriptive method with a qualitative approach because it requires an understanding of what happens in the business processes in the traceability rental equipment system run by oil and gas supporting companies. The flow of this research is as follows:

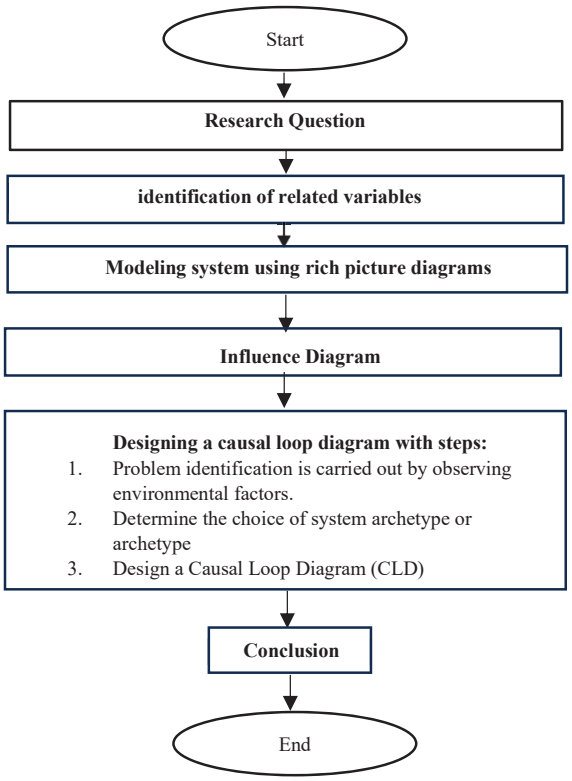

Figure 1. Flow chart

Apart from that, it is also necessary to understand how far efforts have been made to improve the quality of business processes. The following are the system stakeholders in this research :

1. Problem Owner: Company owner
2. Problem Solver: Project Manager, IT development
3. Problem Customer: Oil and Gas Companies
4. Problem User: Operational Department. Technician, Equipment user (customer)

3. RESULTS AND DISCUSSION

3.1. Rich Picture Diagram

The goal of creating a rich picture is to capture, informally, the main entities, structures, and points of view in a situation, ongoing processes, current known problems, and any potential [19]. The rich picture for traceability of equipment in OIL and Gas Companies can currently be seen in the image below:

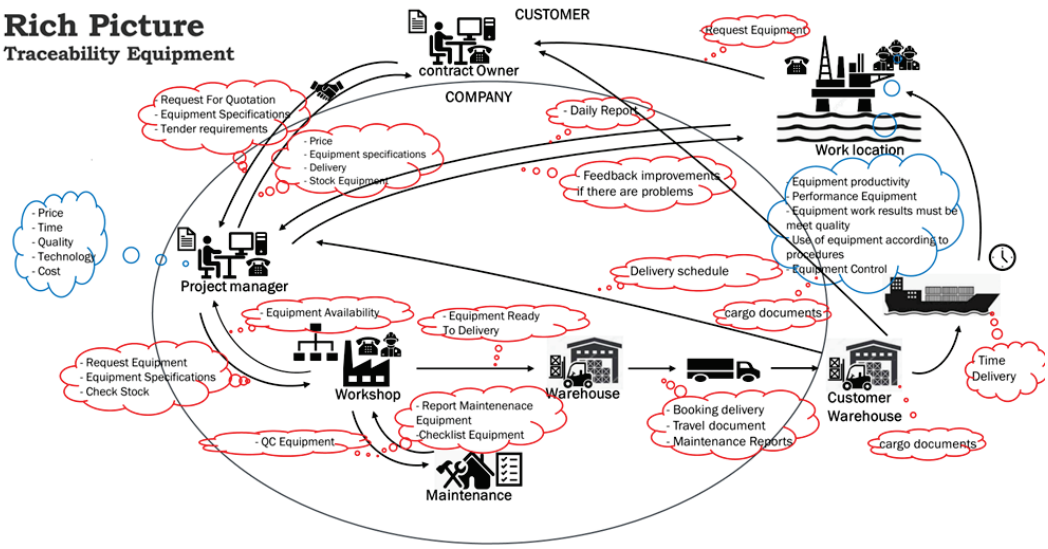

Figure 2. Rich Picture Diagram

3.2. Influence Diagram

Creating an Influence Diagram aims to describe the relationship and influence between components involved in the system [20]. The Influence Diagram from this research can be seen as follows:

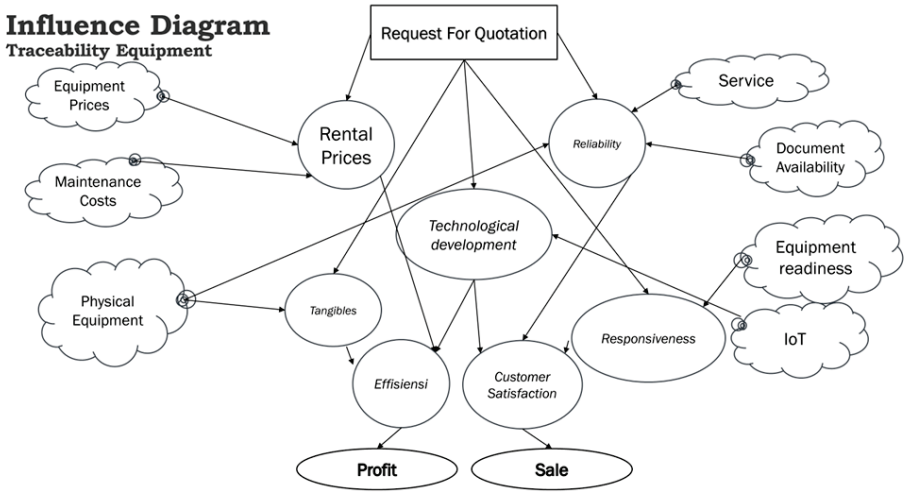

Figure 3. Influence Diagram

3.3. Causal Loop Diagram (CLD)

The CLD model is a model that is widely used in solving problems with a system approach that considers the dynamic complexity of the system or to support a dynamic system approach [21], [22], [23]. The CLD model emphasizes its attention to the cause and effect relationship between components between the factors that are influenced in a diagram in the form of a curved line ending with an arrow that connects the system components to each other. [24]. Data analysis uses a causal loop diagram (CLD) using the following process [25]:

1. Problem identification is carried out by observing environmental factors that have a direct or indirect influence on ongoing business processes.
2. Determine the choice of system archetype or archetype, namely the Limit to Success (Growth) archetype pattern, remembering that business processes at a certain point will experience obstacles to growth due to various reasons
3. Design a Causal Loop Diagram (CLD). After obtaining the relationship between various variables and the company's service quality, a Loop diagram was prepared using the Vensim application program.

CLD modeling, using the Vensim PLE v.32 (Vensim32) software program as a tool in describing the CLD. With the following process:

1. Identify Causal Loop Diagram (CLD) Variables
   Based on environmental observations that have been described in the observation findings, it can be concluded that there are 17 internal and external service factors. These environmental factors are transformed into variables that are value-free but have certain behavioral patterns, that is, if a variable changes, it will influence other variables according to its behavioral pattern. The selected variables are as follows:
   a. Request For Quotation
   b. Efficiency
   c. Customer Satisfaction
   d. Rental Prices
   e. Tangibles
   f. Technological development
   g. Reliability
   h. Responsiveness
   i. Equipment prices
   j. Maintenance cost
   k. Physical equipment
   l. IoT
   m. Services
   n. Availability
   o. Equipment readness
   p. Profit
   q. sales
2. Determining the basic pattern of the system or Archetype Limit to Success (Growth) pattern.
   From the variables mentioned above, one reinforcing loop and one balancing loop can be described. The basic pattern can be seen as in Figure as follows:

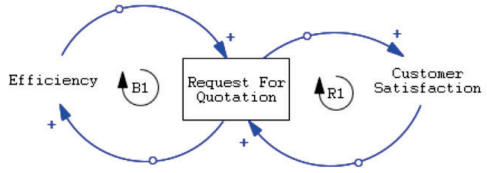

Figure 4. Pola Aarchytype

The higher the Request for Quotation, the higher the level of customer satisfaction, which becomes a reinforcing loop, namely a loop that encourages growth. The higher the Request for Quotation, the higher the demand for efficiency, but with weak efficiency, this will result in a decrease and even result in a reduction in the Request for Quotation given. This situation becomes a balancing loop, namely a loop that limits the growth process. This condition will give rise to a behavior graph / Behavior Over Time / BOT.

3. Causal Loop Diagram (CLD)
   Based on the basic pattern above and the selected variables, the Causal Loop Diagram (CLD) modeling is as follows:

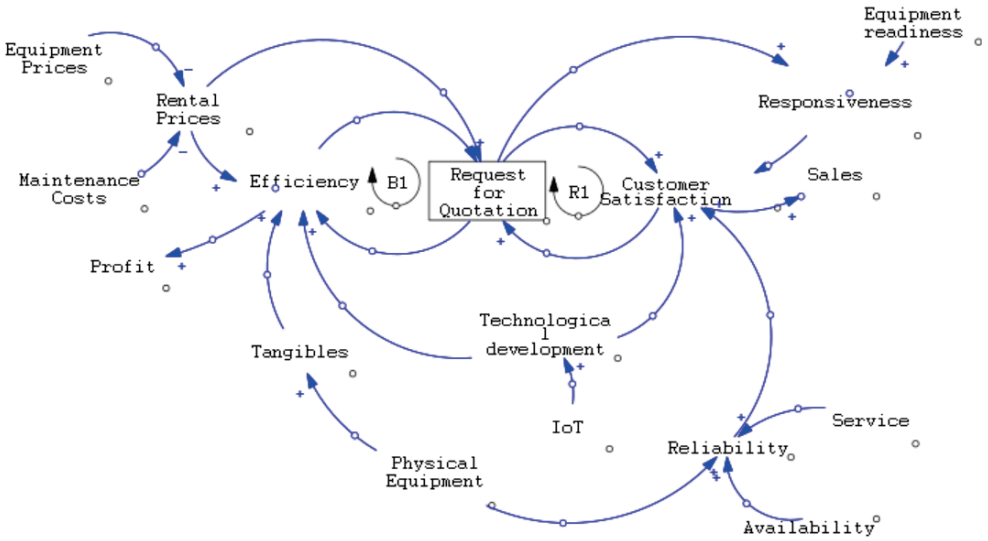

Figure 5. Causal Loop Diagram (CLD)

Tabel 1 Table of Cause and Effect

No	Factor	Cause and effect
1	Request For Quotation	Positive Influential to the increase in Efficiency, Customer Satisfaction
2	Efficiency	Positive Influential to the increase in Rental Prices and Tangibles
3	Customer Satisfaction	Positive Influential to the increase in Technological development, Responsiveness, Reliability
4	Rental Prices	Positive Influential to the decline in Equipment prices, Maintenance cost
5	Tangibles	Positive Influential to the increase in Physical equipment
6	Technological development	Positive Influential to the increase in IoT
7	Reliability	Positive Influential to the increase in Physical equipment, Services, Availability
8	Responsiveness	Positive Influential to the increase in Equipment readiness
9	Equipment prices	Negative Influence on Rental Prices
10	Maintenance cost	Negative Influence on Rental Prices
11	Physical equipment	Positive Influential to the increase in Reliability, Tangibles
12	IoT	Positive Influential to the increase in Technological development
13	Services	Positive Influential to the increase in Reliability
14	Availability	Positive Influential to the increase in Reliability
15	Equipment readiness	Positive Influential to the increase in Responsiveness
16	Profit	Positive Influential to the increase in
17	sales	Positive Influential to the increase in Customer Satisfaction

4. CONCLUSION

Problem solving carried out using the Causal Loop Diagram (CLD) model produces dynamic factors related to cause and effect problems that influence the traceability system implemented in the Company. To increase Request For Quotation, you must pay attention to the level of efficiency, customer satisfaction, and rental prices. High rental prices are influenced by maintenance costs and high equipment prices which also have an impact on decreasing efficiency and customer satisfaction. If the rental price is low it will increase efficiency and customer satisfaction which has a direct effect on profits and sales. Besides that, there are other variables that must be considered, such as tangibles, reliability, responsiveness, technological development, etc. which also influences the Request For Quotation. The results obtained are in the form of a Causal Loop

Diagram (CLD) model which functions as a strategic effort in order to improve the quality and efficiency of oil and gas supporting companies..

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BIOGRAPHIES OF AUTHORS

Asep Endih Nurhidayat received the B.Eng. degree in Industrial Engineering from Institut Teknologi Indonesia, Tangerang, Indonesia, in 2006, and the master's degree in Industrial Engineering from Universitas Mercubuana, Jakarta, Indonesia, in 2011, respectively. He also lecturer, Department of Industrial Engineering, Universitas Indraprasta PGRI. He can be contacted at email: aennoerhidayat@gmail.com

Rina Fitriana received the B.Eng. degree in Industrial Engineering from Trisakti University, Indonesia, in 1998, and the master's degree in Operation management from Sekolah Tinggi Manajemen PPM, Jakarta, Indonesia, in 2000, Doctoral degree in Agricultural Industrial Technology. she can be contacted at email: rinaf@trisakti.ac.id

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is hereby awarding this certificate to

Asep Endih Nurhidayat, Rina Fitriana, Didien Suhardini, Asri Nugrahanti

as **Author(s)** for paper entitled

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