Implementation of SISTRO (Truck Scheduling System) to Enhance Supply Chain Efficiency and Performance to Support Industrial Revolution 4.0 in Petrokimia Gresik

Budi Setiawan(✉)

University of Airlangga, Surabaya, Indonesia
buss.corpltd@gmail.com

Abstract. SISTRO, a truck scheduling and management system, was developed to optimize stock fulfillment following the government regulation (Peraturan Menteri Perdagangan/Permendag) and the distribution process of subsidized fertilizer from Gresik Warehouse of PT Petrokimia Gresik (PG) to Buffer Warehouse located in almost every province in Java Island. The volume that must be distributed is around 5.4 million tons of fertilizer/year. During the implementation, a critical problem is the lack of integration and single information about the supply chain and truck loading process. The information includes (1) truck arrival delay, (2) the difference between planning and reality, and (3) the availability of workers. These three pieces of information are out of sync, so they have direct and indirect impacts. The direct impact is the potential for unscheduled open storage (OPS) in Gresik warehouse. At the same time, the indirect impact is the high logistics costs in the form of land transportation cost increases every year and the potential to lose the opportunity/moment to sell goods due to delays in fertilizer distribution. Therefore, a solution is needed by creating an integrated system to accommodate related parties in truck schedule arrivals, stock availability, and labor availability in the loading line warehouse, hereinafter referred to as SISTRO. The SISTRO's scope of work starts from the distribution of quota allocations for heavy loading that has been adjusted to stock conditions and loading capacity in each warehouse so that the truck vendors can book the loading plan according to the schedule they want, based on the POSTO that has been uploaded on the SISTRO application and partners will get a booking code. The booking code will later be printed as a security pass. The security pass will later be scanned at all SISTRO checkpoints, which is proven can reduce the number of late arrivals for trucks to load appropriately from an average of 1.361 events/month to just 553 events/month. This project impacts several sectors, including reducing the risk of losing chances to sell goods that previously averaged 24,034 tons/month equivalent to Rp. 110 billion/month, a decrease in the OPS quantity (which is currently happening due to oversupply that does not match with quantum distribution). There has been no increase in inland transportation costs for 3 years and monitoring all license numbers and transportation partners so that there is no combined number of registration numbers. In fact, SISTRO can be used by all logistics companies.

Keywords: supply chain · warehouse · fleet management · integration · planning · industrial revolution 4.0

1   Introduction

According to the Regulation of the Minister of Home Affairs of the Republic of Indonesia Number 15/M-DAG/PER/4/2013 article 10 paragraphs 1 and 2, PT Pupuk Indonesia (Persero), PIHC, is obliged to guarantee the availability of subsidized fertilizer stocks for at least three upcoming weeks. In fact, the Minister of Agriculture Decree provisions in June to September 2017 administer that it should only reach the average of 82%. The condition impacts various sectors, including the lack of subsidized fertilizers in the field that makes the selling price of fertilizer above the Maximum Allowed Retail Price (HET), and of course, it also affects PG, which causes a reduction in the price of the allocation of fertilizer subsidy. The following problems cause failure to meet stock fertilizer in Warehouse Line 3: 1. Congestion on weighbridge at a specific time with 72 events/month on average. 2. Poor loading information flow management: average frequency of occurrence flow management problem with less loading information reached 1388 events/month. 3.

The incoming truck document does not meet the required standard, with 23 events/month on average. From the Pareto diagram, the problem of poor loading information flow management of 1388 events is equal to 94%; thereby, a way out and improvement are required to address the issue. The improvement project aims to reduce the frequency of trucks' late arrivals from 1361 to 925 events/month by creating an integrated system for all stakeholders (Fig. 1 and Table 1).

From the list of alternative solutions considered, the project team decided to develop the application titled SISTRO (Online Truck Scheduling), which is a multi-mode (web and mobile)-based application that functions as a truck scheduling medium to carry out the loading process at the Warehouse Line 1. All data has been integrated online and in real time. With SISTRO, tracking the truck's position becomes easier. Today, nearly every company, financial institution, and government agency are struggling to design their digital business models to deliver remarkable customer experiences, profitability, increase market share, and attract employees. Consumers and other stakeholders expect to engage with businesses anytime, anywhere, using the technology they carry in their pockets, via mobile apps or social channels. Mobile apps have changed how, when, and where work is done. Employees are more productive when they work and collaborate easily through handheld or wearable devices [1].

It takes much effort to manage multiple business functions in some business aspects. The operations function plans and coordinates all the resources needed to design, manufacture, and ship products. These business functions involve complex processes that rely on data access, collaboration, communication, and data analysis to determine what must be done and employees' workflow to achieve this. While most attention is focused on external interests - customers, competitors, and partners - they are only part of the solution. Business success also depends on internal factors - the efficiency and effectiveness of managers, employees, and core business processes and functions [2] (Fig. 2).

In logistics management, information systems handle the coordination of multiple complex processes, such as outbound logistics activities to optimize transportation
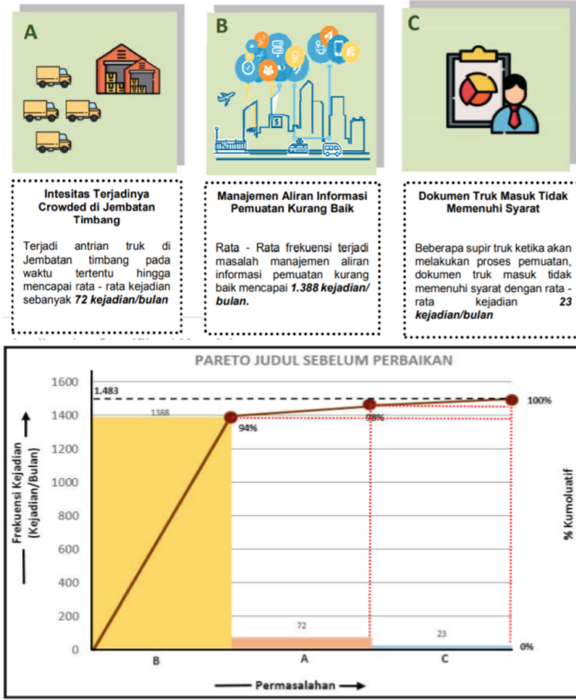
Fig. 1. Possible Root cause for Congestion and Problem Identification.

Table 1. Quality Impact of the Problem.

| Aspect	Before Improvement	Targets After Improvement
Quality	Delay in the truck's arrival to fit frequencies averaging 1361 event/month.	Delay in the truck's arrival for loading and unloading to 925 events/month.
Cost	Potential of losing chances to sell estimated items an average of 24034 tons/month, with an average turnover potential IDR 110,653,260,000/month	Reducing the occurrence of losing chances to sell the average estimate of 6500 tons/month, with an average turnover potential IDR 25,000,000,000/month
	Potential unscheduled open storage (OPS) of IDR 1,720,309,352 equivalent to 23,456 tons	No OPS Quantum (Whole fertilizer distributed according to the allocation)
	There is an increase in land transportation costs each year of 7%/year on average, equivalent to a cost IDR 49,247,215,654/year	There is no increase in land transportation costs because there is a certainty that the truck will come to load
Delivery	Long time in delivery information that takes 2 h	Time to deliver correct information quickly (30 min)
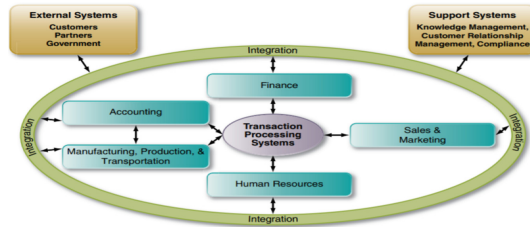
Fig. 2. Data from functional area ISs support enterprise applications.

operations, coordination with all suppliers, integrating supply chain technologies, synchronizing the in and out flow of materials or goods, and managing distribution or transportation networks. These systems enable real-time monitoring and tracking of supply chain shipments, schedules, and orders [2].

APICS, a supply chain and operations professional organization, defines logistics as "the art and science of acquiring, producing and distributing materials and products in the right place and in the right quantity. Trucks are commonly used to transport goods over land as they provide a great flexibility to deliver goods to almost any location that is not separated by water. The product's size, weight, liquid, or volume can be adapted in this mode [3].

2   Research Methods

This study and project were conducted by searching the literature and sources of information on the internet related to the problem, gathering related data and information regarding the topics, conducting the development, and evaluating the after process: 1. Gather sources of information and existing literature. 2. Problem analysis and stratification. 3. Set goals and determine the causes. 4. Conduct cause and effect analysis. 5. Determine the dominant causing factors. 6. Planning repairs with 5W + 2H. 7. Repair plan schedule with S-Curve. 8. Observation of implementation results. 9. Compare implementation flow before and after.

3   Results and Discussion

To develop the project, the team started with brainstorming existing business processes, identifying truck loading workflow in the warehouse from the issuance of PO until the realization of loading and then agreeing on forthcoming business processes and the new truck loading flow with all stakeholders. After the business process was agreed upon, the team created a blueprint for each business process and a detailed framework for preparing truck loading business processes using the SISTRO application.

Procurement of infrastructure for server (license, storage, and network) license, storage, network was then executed to SISTRO server. Afterward, procurement of infrastructure for clients/users (computers, scanners, QR code scanners, printers, and PC) to support SISTRO implementation took place. During the SISTRO development, the

team created database and user interface designs and finalized distribution area database, transporters, warehouses, trucks, scales, and security posts and created a website. Afterward, the team constructed script coding programming of the system, performed website coding script construction, conducted system testing with each stakeholder, tested the SISTRO application with all stakeholders, performed system testing and repair, and performed system repairs if an error occurs. To carry out change management, socialization and implementation to transportation partners and related units for the loading business process were implemented. The team also delivered end-user training for all stakeholders to ensure the SISTRO application usually runs [4].

Figure 3 exhibits the SISTRO ecosystem to support the business process in the logistic stream and provide integration and a single system point. All external and internal parties access the system in a simultaneous and integrated manner. The features of the application are as follows: Truck Loading Scheduling that provides the benefit of loading certainty obtained from the calculation of the loading slot/quota by considering the conditions of production and stock in the warehouse. Loading Fleet Tracking The feature used to track the presence of the loading fleet at the SISTRO checkpoint in the factory area. Load Ticket Printing is used to scan checkpoints in the factory area and is integrated with several warehousing and weighing applications [5].

The SISTRO details are as follows: 1. Main dashboard: The main view of the website that is often used to provide information regarding the distribution of fertilizers. 2. Period and Quotas Management: Quota management menu for each period that is useful for distributing fertilizer stock in each distribution area and transporter limits for booking trucks. 3. Report: To see the realization of loading per POSTO, transporter performance, truck ticket bookings, and period per date and region. 4. Truck Queue: It is a truck queue management in the PG area so that the weighing and warehouse officers can monitor. The weighing officers have a role in managing the queue in each warehouse because there are 7 (seven) loading warehouses. 5. Warehouse stock: Warehouses can update real-time regarding fertilizer stock in each warehouse so that distribution staff can find out and as a determinant for opening quotas every period. 6. Ticket Scanning: Scanning
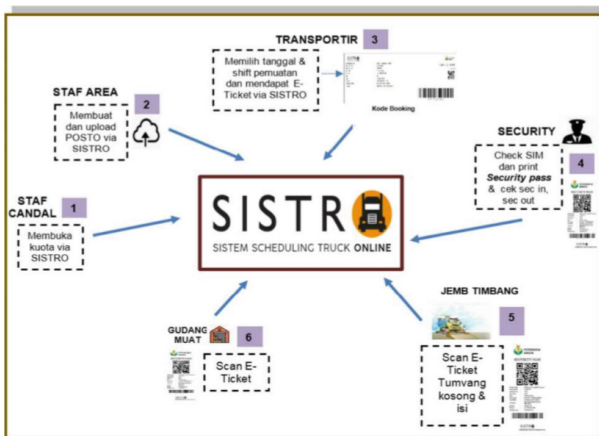

Fig. 3. SISTRO as an integrated business information system in logistic.

tickets is helpful in tracking trucks in the PG area. Scan tickets are done at security, scales, and loading warehouse. 7. Ticket Booking: Transporters to book truck tickets according to the quota that has been opened by the distribution staff every period (days and work shifts) [6].

The loading process flow chart comparison is depicted in the following Figs. 4, 5 and 6. It shows PG Fertilizer Distribution/Transport Model after improvement and SISTRO implementation.

The standard operating procedure and the duties of the warehouse officers/heads are as follows: 1. Area staff must plan for opening quota both daily and periodically (10 days) based on information/stock conditions, production results, and the availability of workers in the Gresik warehouse. 2. Trucks that will load subsidized fertilizers at the Gresik warehouse must carry loading documents, both hardcopy and softcopy (in the form of photos), of Booking Tickets generated from SISTRO [7].
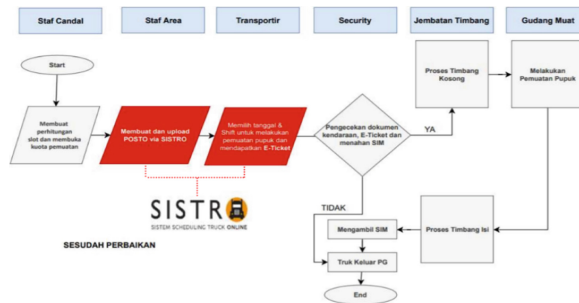

Fig. 4. Petrokimia Gresik Fertilizer Distribution/Transport Model after improvement and SISTRO Implementation.
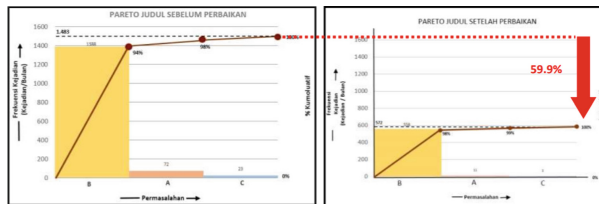

Fig. 5. Comparison of Data Sources and Pareto Diagram Before and After Improvement.
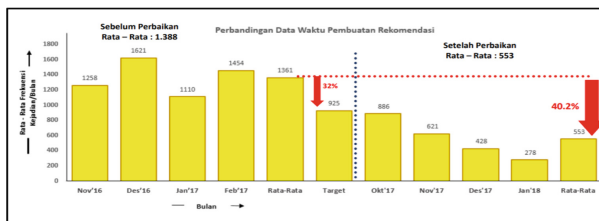

Fig. 6. Comparison of Recommended Time Data Before and After Improvement.

Fig. 7. Request Realization Data From October 2017 to December 2018.

3. Each officer will scan tickets at each point, including Entering Security Post, Weighing Empty truck, Loading Warehouse Before, Loading After Warehouse, Weighing Contents, and Exiting Post Security. 4. The number of trucks allowed to load fertilizer at PG must be registered with SISTRO and not more than one PT (combined truck).

The results of the projects are then standardized and currently in the process of submitting a Patent Rights to protect Intellectual Property Rights (HAKI) to the Department of Law of PG. Socialization to end-users has been carried out externally and internally to support understanding and standardization of the processes needed to run the SISTRO application [7]. As a sustainable innovation, the checking process is carried out by comparing the average data for requests that are not served during June to September 2017 with the realization data request from October 2017 to December 2018 with the following results shown in Fig. 7.

4   Conclusion

From the project and study that have been done in PG, the authors can conclude: 1. From the Pareto chart, it can be seen that the accidents decreased by 59.9% or equivalent to an average of 572 events/month which was initially 1428 events/month in the area of (1) poor loading information flow and management, (2) intensity of truck congestion at the weighbridge, and (3) incoming truck documents that are not complete. 2. Regarding loading information flow management, the frequency of the recommendation time data after the improvement has decreased by 40.2% or equivalent to 553 events/month from the predetermined target.

Besides, the project also brings benefits to related stakeholders such as: 1. Team members understand better and are helped by the Online Truck Scheduling System. 2. Other working units related to the project are helped to facilitate inland transportation staff in scheduling fertilizer delivery to the Buffer Warehouse (Plotting Order), because it is supported by real-time data related to the number of queues and stock conditions. The loading process in the warehouse becomes smooth, a suitable loading schedule ensures the certainty of the number of available workers. 3. For PG, the need for subsidized fertilizer stock is met, reducing potential loss to sell goods to an average of 5,512 tons/month or equivalent to IDR 22,948,085,000/month. There is no increase in inland transportation costs for 3 years due to the certainty of loading; 4. Truck vendors will enjoy guaranteed loading certainty increased fleet utility and can track the status of the fleet loading in the Petrokimia Gresik area.

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