Designing an Integrated Logistics Information System

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Abstract. A state-owned enterprise construction company has many projects that need a logistics process to ensure supplies deliver on time. Currently, there is no logistics planning when project PIC (person-in-charge) requests the logistics to DSCM (Supply Chain Management Division) impromptu. With limited resources in DSCM, it is overwhelmed because there is no logistics process standardization with a lack of controlling the logistics status, such as real- time position. Nobody can track the status directly, except DSCM calls 3PL (third-party logistics) to get information. The implementation of the HSE (health, safety, and environment) is not optimal due to nobody ensuring the HSE implementation. The reporting is done manually and takes at least a week. These long lead processes time can affect the logistics cost inefficiently. If the logistics cost increases, the profitability will decrease. The solution is developing a cloud-based system that integrates with internal and external databases, called an integrated logistics information system. This system can provide a standardized logistics process to facilitate the planning and request order. The position tracker is included to provide real-time tracking of the delivered cargo. Due to its cloud-based system, it is accessible to access everywhere at any time. Currently, the system is designed in flowchart form and for its future implementation plan, it will take around thirteen months from development until its implementation as a pilot project. The projections of the system will be reducing the leads time and logistics cost, thereby the logistics cost can run more efficiently, and the company's profitability will increase.

Keywords: Logistics · Integrated · Real-time · Planning · Tracking

1 Introduction

A state-owned enterprise construction company has many projects, and every project requires project goods, such as concrete, iron steel, cement, etc. These goods are logistics goods that require transportation from supplier to project site to provide the infrastructure process. With a large amount of logistics transportation needed for all projects – both holding company projects and subsidiaries – planning is necessary so that all procedures can run correctly and adequately.

At present, the logistics planning is running manually. First, in choosing the logistic transporter, called third- party logistics (3PL), the 3PL must be listed and verified on

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the company's website. The logistics PIC (person-in- charge) in the Division of Supply Chain Management (DSCM) will select the 3PL company that already has a long-term contract or the 3PL company will be appointed by the solicitation process. The chosen company will start to do the logistics process according to the agreement under insurance protection.

Based on an interview with the procurement staff that already worked in the company for eight years, many logistics needs sometimes make overwhelmed due to limited resources that plan and control the logistic.

process. The logistics process is unstandardized yet, which causes the project can request the logistics impromptu to DSCM. The tracking status on cargo is still not obtained with real-time information. Frequently, the staff should call the 3PL PIC, the driver, or the ship captain to get real-time information about the location status or the time that they might arrive. When there is a problem, the troubleshooting process has a long lead- time because there is no real-time status information. Moreover, the implementation of the HSE (health, safety, and environment) is not optimal because even though it is written in the paper, but not broken down into detailed statements. There is no one ensuring the implementation, and if any accident happens, it could influence the project timeline that probably delays.

Last, the document reporting system is done manually to generate the paperwork that takes at least a week if no accident happens along with the delivery. The staff should take some information or documents in different places, frequently input duplicate initial information to get the related documents. This process is not efficient due to long-time process to obtain information or documents data. In this Industry 4.0 era, it is very inefficient due to the high lead time of the logistics process.

For management view, the logistics cost also needs to be considered. Currently, the logistics cost is around ten to fifteen percent of the value of the goods. Meanwhile, reducing logistics costs will reduce the total cost as well. When the total cost reduces, the profit generated will increase. Therefore, the company needs to reduce the lead time and logistics cost to increase the company's profit. According to the interview result with the company's logistics staff, who has been working for four years, the company has targeted to reduce the logistics cost to eight percent. It means the logistics cost is streamlining by about two to seven percent. If the logistics process can be efficient, there will be no doubt that the logistics cost will be efficient also.

2 Literature Review

2.1 Logistics Management

Logistics management is management functions that support the complete cycle of material flow: from the purchase and internal control of production materials; to the planning and control of the work-in-process; to the purchasing, shipping, and distribution of the finished product [1]. It is about the movement or distribution of products, consequently, it must be as efficient as possible because it will affect the final cost of the product. Many logistics companies have been years in the logistics industry, such as DHL, FedEx, and so on goods until received at the destination site. In this case, the documents such as invoices are delivered together. The warehousing is a storage element for goods to collect

and pick that ship to the destination. The transport service becomes a bridge of spatial distance between origin and destination location.

2.2 Transportation Management System

A big company usually has a lot of competencies that need to do to achieve its vision. While many things are working by company, a company can lose its focus on core competencies without consciousness. Therefore, this construction company uses outsourcing companies to do something outside the company's core competencies; for example, a third-party logistics (3PL) company handles the logistics.

Outsourcing is an act of moving some of a firm's internal activities and decision responsibility to an outside provider with an agreement is established in a contract [1]. The 3PL is an outsourcing logistics company that is an expert in the logistics sector and will help a firm do another critical element in the logistics process, therefore a firm can save more cost and time. They will handle and deliver the goods under a contract agreement. They usually also have a tracking technology system that reduces some risks in the logistics process. It provides tracking data using electronic data interchange.

Logistics management has system service components that support logistics activities. There are logistics core services, information services, and additional services, as shown in Fig. 1 [2]. When all elements run together, there will become holistic logistical services. The core services consist of order processing, warehousing, and transport service. Order processing is an initiation element that provides order data from the beginning and promises to monitor the.

technology and satellite system to tell customers exactly where the goods are and when deliveries will arrive [1].

The electronic data interchange technology used is called software as a service (SaaS). It integrates some external systems into a cloud-based portal system, such as

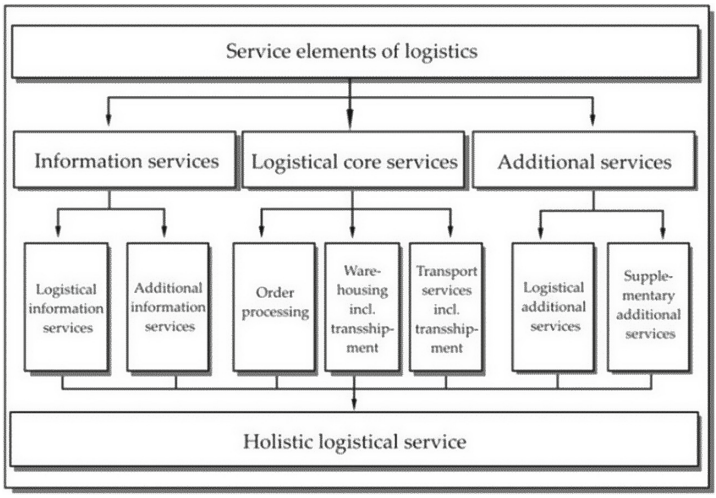

Fig. 1. Service Elements of Logistics [2]

GPS mobile, database collections, and so on. This SaaS is mainly about transportation management systems (TMS). When a service does manually, it should collect all databases manually also, and when needed to search or track the exact data, it will cost more time. Manual service cannot give real-time data when it moves, and it needs more labor to execute data. With the SaaS system, customers can get easy access to track data, and a firm can be helped by collecting the databases, therefore there will be an efficient number of work-labor and saving more time.

2.3 Modeling

Modeling is an engineering technique that helps to visualize the architectural model. In other words, modeling is a simplification of reality [3]. Modeling is an essential process because it explains the system before it develops. It also can give allowance to specify the structure or behavior of the system iteratively and incrementally.

In modeling, the principal is choosing the suitable model. It can provide insight that would not otherwise have because the wrong model will take attention too much in the wrong direction or irrelevant issue. The suitable model also focuses on entity-relationship that define the system's behavior. Therefore, when constructing the model, it should be well-planned and understandable by any user as a form of a suitable model.

2.3.1 Unified Modelling Language (UML)

The architecture models will construct using a language, named Unified Modelling Language (UML). The UML is a standard language for writing software blueprints to visualize, specify, construct, and document the artifacts of a software-intensive system [3]. It provides an executable model at different levels and details; for instance, the user will focus on what issue, but the developer will focus on how issue. Therefore, generating a suitable architecture model needs several interrelated views of UML, such as use case diagrams and activity diagrams.

2.3.2 Use Case Diagram

Use case diagram is a diagram that describes an interaction between stakeholders and internal-system functions [4]. It explains what the system does and how the actors use it, but not how the procedure operates internally [5]. It helps to identify the system's requirements so that the stakeholders can understand the activities in the system. Figure 2 shows the example of the use case diagram.

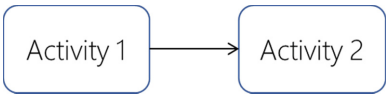

Fig. 2. Illustration of Activity Diagram

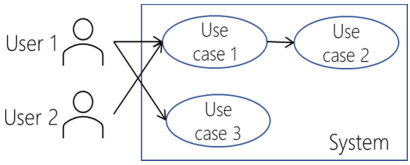

Fig. 3. Example of Use-Case Diagram

2.3.3 Activity Diagram

An activity diagram illustrates the workflow activities in the system. It does not show the activities carried out by the actors. It uses activity nodes and edges to model the flow of control and data between actions, as illustrated in Fig. 3.

3 Analysis of Business Situation

Currently, four stakeholders are involved in the logistics process: project's traffic that acts as a person who manages the logistics for the project, person-in- charge (PIC) logistics of Division of Supply Chain Management (DSCM) that acts as a person who cares the 3PL and insurance companies for the project's logistics request, the 3PL that provides the logistics process as a logistics outsourcing company, and insurance company that covers the insurance for company's logistics process. The company also has its transportation planning. First, the project controls its logistics by traffic. The traffic will forward the logistics request to the PIC logistics. Frequently, the traffic manages the logistics unplanned and impromptu. For instance, today the project PIC (traffic) forwards the logistics requests, but for the next two days, the traffic forward another request with the same destination. This situation indicates that the company's logistics situation is incoordination.

After the traffic places the requests, the PIC logistics will start to find the third-party logistics (3PLs) that meet the requirements of the transportation plan. At first, the 3PLs should be listed and verified in the company's vendor platform that manages the vendors that already passed the pre-qualification. PIC logistics can choose from one of 3PLs that already has a long-term contract or choose from one of three to five selected 3PLs by solicitation process. After that, before the 3PL brings the cargo, the insurance must cover the logistics process. The insurance company is chosen from one of the insurance companies. The companies have a long-term agreement. On the other side, if it is an export or import cargo, the customs clearance administration process proceeds in the company's customs information management platform. When the customs documents are ready, the PIC logistics will send the documents to the customs duty office. All these activities run independently.

When all administration documents are ready, the 3PL may deliver the cargo. Typically, shipment is dispatched either by land vehicle (truck) or water vehicle (vessel). At this time, no tracking system can track in real-time position. PIC logistics only receives.

information from the 3PL provider about the cargo's status, such as whether it has already arrived, is almost there, or has any problem. If the shipment almost arrives, the project cannot prepare for the receiving process from the beginning. Indeed, if there

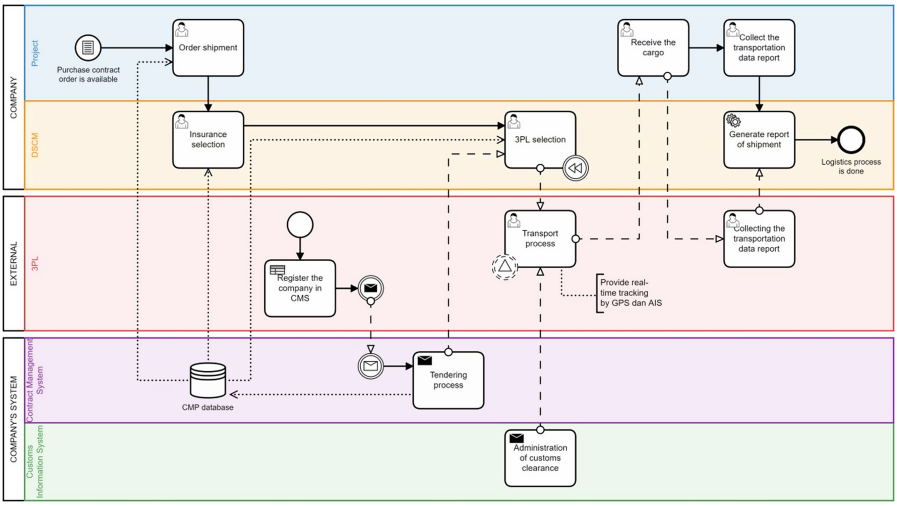

Fig. 4. Existing Logistics Business Flowchart Model

is any problem, the troubleshooting process needs more time, about a month to six months or more. For instance, some bundles of steel pipe were different in quantity from the list. Each bundle had its tag with the amount of each bundle written on the labels. Unfortunately, at the receiving point, the actual quantity of some bundles was dwindled and different from the tags. Troubleshooting took a long time to determine if the steel pipes were stolen midway or dissimilar from the beginning when loading the cargoes from supplier to truck. Insurance might have covered the incident, but when there was no evidence of the original condition, troubleshooting might take about three months or more because, for events not included in the clause, the insurance company did not wish to be the aggrieved party.

The receiving process is as crucial as the loading process. At this stage, calculations for the shipment must be accurate since they will affect the insurance company that covered the logistics. There were some cases at the first loading process - the cargoes were dissimilar from the packing list. There are other instances where, at the receiving point, the cargo quantity was different due to a lack of quality control at the first loading point or theft. Currently, there was no documentation or proof of delivery of the cargo. Therefore, if any same cases happen, troubleshooting will not be easy. At the receiving point, the documents are collected manually also the reporting is generated manually. A logistics report is worked on within a week. Further, if there is a troubleshooting process, the documents will take longer to complete.

4 Business Solution

The business solution is developing a cloud-based system integrated with internal and external databases, such as 3PL's in-stock fleets data, called an integrated logistics information system. This system can provide standardized logistics business process to facilitate the planning and request order from the project to DSCM. It is also possible to track

the cargo delivered by the 3PL company in real-time using a tracking system. Due to its cloud-based system, it provides easier access that is accessible everywhere at any time. The new system is in flowchart models and divided into three types of models: inland with single-mode transportation, multimode in the domestic area, and multimode in the international area with developing in prototype model for internally used only.

4.1 Use Case Diagram

The use case diagram illustrates the interaction between the user and the system. Figure 5 depicts the diagram. The project, DSCM, and 3PL are the three primary users in the system with seven prominent use cases: user login, order shipment, insurance company selection, 3PL selection, delivery process, data report, and master data.

The project user has functional use cases that include in the system, there is login and order shipment, while data report is being a general interaction. These.

the same manner, however, there are differences in that the user can add invoice bills, tax invoices, delivery notes, and other complementary documents as well. The login is similar to others. The delivery process is crucial because it has loading, transport, and unloading process use cases that handle carefully. In this use case, the documentation,

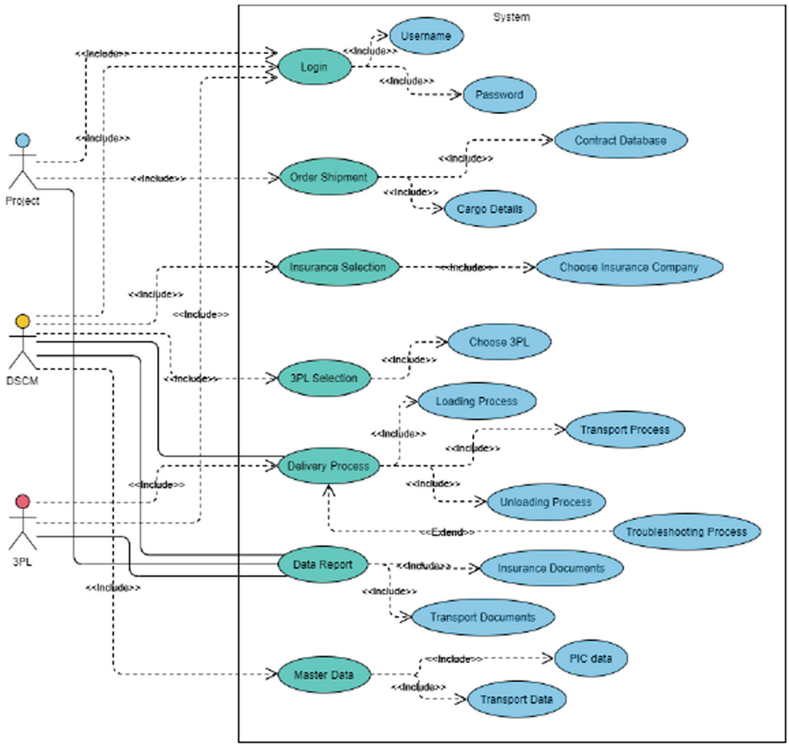

Fig. 5. Use Case Diagram of Integrated Logistics Information System

tracking system, and notification details information include in the activities. Whenever a problem occurs, troubleshooting should take place until it is solved.

4.2 Flowchart Diagram

A flowchart diagram is built to visualize and understand the new internal logistics business process by combining several activities. Figure 6 depicts the new logistics business model. The new model integrated and digitalized the administration and paperwork-based operation. The details of the functional use cases require the user to execute the.

actions: logging in as a project user by entering username and password and ordering the logistics shipment by selecting the contract database and inputting the cargo details. The user generally interacts with the data report use case because this use case is triggered when the user has to input additional transportation data reports, such as delivery orders and minutes of handover. In this use case, the user can also generate the shipments resume if needed, whether by saving it in the cloud database or printing the documents.

The DSCM user has functional use cases that include in the system there are login, insurance company selection, 3PL selection, and master data, while data report and delivery process are being general interactions. The login use case is as same as in the project user. The insurance company selection and 3PL selection require the user to select the insurance company to cover the logistics insurance and 3PL as an outsourcing company that provides the logistics process. The data report use case is also as same as in project user with the master data belonging to DSCM user only because it maintains the database about PIC data of all stakeholder users and transport data. The delivery process confirms that the 3PL company has arrived at the destination or is still en route.

While 3PL users have functional use cases that include login and delivery processes, data reports are generally interacting with the project and DSCM users in model will be analyzed and divided into three parts: inland with single-mode transportation, the domestic area with multimode transit, and the international area with multimode transit.

The three flowcharts have similar flow, business models. First, the project placed the order shipment by selecting the contracts, such as contract names, contract values, supplier details, and the project division, from a contract management system (CMS) database. After that, input the cargo details, such as name and code of the cargo (resource), weight and quantity, supplier PIC, origin and destination coordinate location, the estimated time of departure (ETD) and arrival (ETA), incoterm, HSE requirement, and other complementary information data. In this stage, the project can select whether the origin will be one or more to deliver the cargo to the same destination at the same time.

After the order shipment is submitted, the DSCM chooses the insurance company that has been listed and has a long-term contract in the CMS database. After selecting the insurance company, the DSCM selects one of the listed 3PL companies and has a long-term contract in the CMS database. When DSCM wants to choose a 3PL company outside the long-term contract listed companies, the tendering process will proceed in the CMS platform with the result sent to the system, and then DSCM can select the chosen 3PL company.

On the other hand, the 3PL company that has a long- term contract or has been selected in tendering process should input or update the data of the available type of

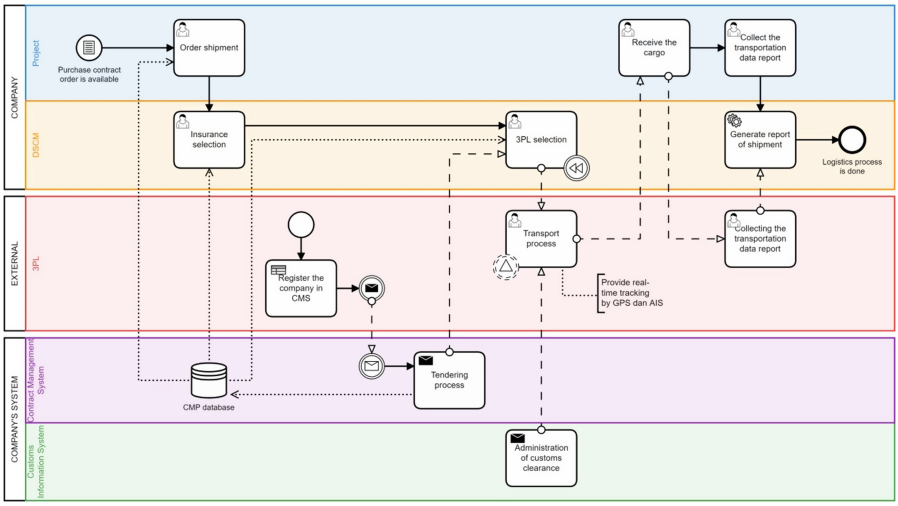

Fig. 6. Integrated Logistics Information System Flowchart Model

model with the quantity and the price. Upon receiving the order, the 3PL company can accept or reject it if some details, such as price, change by fulfilling the clauses. The 3PL may change it then take the order.

After the 3PL has received the order, the DSCM will generate the insurance purchase order (PO) and send all transportation details, such as cargo details, 3PL company, and contract documents, to the insurance company. When the insurance company receives the documents, the company should issue a cover note as a letter of approval that the shipment is insured. While waiting for the information from the project if the cargo is ready to pick up, the 3PL may add and changes mode details data, such as truck details and the ship particulars with the driver details information that also be submitted. In this stage, the project can change the ETD and ETA with the project, DSCM, and 3PL agreement.

When the cargo is ready, the 3PL starts loading the cargo. Each driver must input the payload listed in the shipment. Each cargo has its list, and the driver must input the name or code of the cargo that appears on the label while attaching documentation of the entire load, each marker or tag, the cargo on each marker, and a delivery order or other accompanying documentation. It is then necessary to adjust the shipment's details by entering the quantity, weight, and dimension of the cargo carried by each truck. It is important to specify any change in the note, such as whether there is a difference in quantity or additional load not stated in the packing list. As proof, the differences must be documented, and the drivers must agree with the statements - that the cargoes are in the right type, quantity, size, weight, and quality with no change - and e-sign the documents. These actions are used to prove the initial condition before delivering the cargoes. All these adjustments will be additional information that sends to the insurance company by DSCM. DSCM should upload the cover note immediately once it has been received, and the notification of the logistics is insured will be displayed. Therefore, the 3PL may deliver the cargoes. When the cover note is issued, the DSCM should pay the

premium within thirty days after its date released. For control, the DSCM should upload the certificate of insurance that has been issued, invoice, and payment receipt to ensure that the premium is paid on time because if it is late, the insurance has the right to be canceled by the insurance company.

Before delivering the cargoes, the system will generate the minutes of factory handover and QR (quick response) code. Every truck will have a QR code that contains information about the details of cargoes that it carries. If the driver or truck has to be changed midway through the expedition, the new driver can scan the previous driver's QR code, check the shipment's list, and e-sign the documents. If the same driver still delivers the cargo with a different truck, the driver can choose a different plate number, check the statement, and e-sign the documents. The GPS technology tracks the real-time position along the way. The system can calculate the ETA and send a notification to the recipient. The system also records the actual departure time (ATD) and arrival (ATA). If it is for inland with a single mode of transport when the cargoes arrive, the project can do the receiving process. Meanwhile, if it is for multimode of transportations – both for the domestic and international area – the process could be longer.

For multimode transport in the domestic area, when the cargoes arrive in the seaports, the DSCM's field PIC decides whether the cargoes will directly load to the vessel or unload to the warehouse first before loading to the ship. The PIC requires to scan QR codes for both activities to ensure the cargoes are the correct ones. The newest documentation also should be done as proof of delivery. The recent ship particulars (if the ship is changed) and port clearance will be uploaded to the insurance company once the cargo is on board. The ship- particular is the details of the vessel, such as production year, gross weight, net weight, and so on. Meanwhile, the bill of lading is a form of port clearance issued by the shipping company as a carriage agreement between the shipper or consignee and the carrier. In the middle of the voyage, the AIS will track the real-time position of the vessel.

For multimode of transports in the international area, the flow is similar to the domestic area model, but with an additional customs information system (CIS) as administrative tools to facilitate customs clearance. When arriving at the destination port, the cargoes should unload to the warehouse earlier before loading to the truck until the customs and excises office issues an Approval Letter of Expenditures (*Surat Persetujuan Pengeluaran Barang (SPPB)*).

When the cargoes arrive at destination seaports, the same decision can decide by field PIC whether the cargoes will directly load to the vessel or unload to the warehouse first before loading to the ship with the exact requirements. The field PIC also can assign the cargoes that should deliver by each truck. All documentation and adjustments should be made as needed with e-sign the agreement documents, and a QR code also will be generated.

When the cargoes are arrived at receiving point, the ATA notification will be sent to the system. The DSCM also can verify whether the shipments are arrived or not by checking the 3PL PIC. Occasionally, the parking lot or warehouse was fulfilled, which required the driver to park their truck near another project site instead of the parking lot or warehouse. The driver must give the delivery orders from the supplier and transporter to the project PIC. They do the same activities in adjusting and documenting the cargoes.

After the shipments are well received and completed, the 3PL can begin returning the container to the depot (if any) and submit the related documents, such as the invoice bill, tax invoice, delivery notes, and other necessary documents. Yet, if it is not, the troubleshooting process should proceed until it is finished by sending a notification to the system that the troubleshooting process is done. The project should submit additional documents of the troubleshooting process. Once the logistics process is complete, the DSCM can generate the resume of shipments.

4.3 Prototype System

A prototype system is developed by software that gathers data from users and converts it into data previews, such as diagrams. These previews appear in the Dashboard column and can provide data such as the project total, the maps that showed total projects in the province area, the value of goods and logistics value with currency filters, and the project name with the number of logistics orders.

The first data that was collected is in the Order Plan column. First, the project PIC input the order plan in this column. Project PIC should select the division and input the contract detail information: contract number, number, and project name. Then, the cargo details should be inputted, such as cargo name, weight, dimension, and quantity. Additionally, the supplier PIC must include details such as origin, destination, ETA, ETD, incoterm, and type of goods. Another information is if the PIC selects the multi-origin, it means that the transporter should load cargoes at two different origins, therefore the PIC should also input other cargo details.

The second column is the Insurance column. In this column, the DSCM logistics PIC selects the insurance company that would cover the logistics order. The order number is the number listed in the Order Plan column. The data inputs include the insurance company, the applicant (the organization that applies to the insurance company), the number of Certificate of Insurances (COIs) in the Insurance Cover Notes, the status of COIs, and the value of the good. In the COI status, 'open' means that the COI is still in process and 'closed' means that the COI is already issued.

The third column is the 3PL Selection column. In this column, the DSCM logistics PIC should input some data of 3PL selection. The PIC should select the 3PL company with the prices that have been negotiated and calculated. Further, the mode's type with quantity and the total shipment's weight should also be entered.

The fourth column is Mode & Driver Details column. The following data are being input: the FitCheck lists (that listed in the form); the truck mode details (such as type of mode, license plate number, registration certificate (*Surat Tanda Nomor Kendaraan (STNK)*) number), the driver details (such as name, phone number, ID card number, and driver license number), and vessel mode details as in ship particulars (such as type of mode, vessel name, registration number, and built a year).

The fifth column is the Load Cargo. In this column, the forwarder (3PL) should input the cargo's tag number that brings by each driver. If there is any additional information, it should submit here.

The sixth column is the Delivering column. In this column, the 3PL should ensure that the delivered cargo is as same as the statement lists. If they agree with the statements, they can click the delivery button.

The seventh column is the Receiving Cargo column. The 3PL must enter the received cargo data at the destination point. When the cargo is well received, the 3PL should agree with the statement that ensures the cargo's type, weight, dimension, and quantity are not changing with non-decreasing quality.

5 Conclusion

A state-owned enterprise construction company will standardize its logistics system by developing a new procedural order concept. The concept is where the project PIC can assign the requested order long before the deadline, the DSCM logistics PIC can process the requested order by assigning the insurance company to cover the logistics, and the 3PL as an outsourcing company to deliver the cargo. This concept will reduce the impromptu unplanned logistics request order from project PIC to DSCM logistics PIC. The system also provides real-time tracking status with QR-code and e- signature features. Moreover, the document reports are produced automatically. A prospect of this system is to reduce the lead time of the logistics process by integrating an automated platform. If the logistics process can be more efficient, reducing the logistics cost is possible, nevertheless with the total cost. When the total cost reduces, the company's profitability will be increase. However, this system is unimplemented yet in actual conditions. It is still in concept form. As a result, all possible successes mentioned in this project are not yet proven.

In implementing the new procedural order concept, a new system is designed to improve the internal logistics business process. The system is called an integrated logistics information system, where the system is developed as a cloud-based system and integrated with internal and external databases for enhancing the database's requirements. The system can directly pull the data needed by a user and process the data to give an output. The system also can provide standardized logistics business processes to facilitate the planning and request order from the project to DSCM. The 3PL is also included in this system and can provide real-time tracking by tracking technology on the cargo whom they delivered. Due to its integration process, this new system can be accessible everywhere by any stakeholders whenever they need it.

Research limitations of this project include the fact that this system is unimplemented yet in actual conditions. It is still in design concept form. Hence, all the successes described in this project are not yet proven. Additionally, the company or system listed as a benchmark company and integrated with this new system developed in this project could be changing or accruing.

6 Further Research

Any future research to improve the current business process would be worthwhile to perform. The recommendations for future research are as follows: (1) in developing the system, the company should find more prospective developer companies that probably have better experience in logistics are. The current developer has owned its logistics process, however, for future research, it is necessary finding companies that only develop logistics systems and do not have the logistics process, (2) in generating the dashboard,

it is significant to conduct big-data analytical research. These can be valuable to future analysis of the database that already happens as historical data and transform into forecasting data. This data can be logistics number of order requests in a month, timeliness of delivery, and the type of delivery route which selected with a real-time travel time calculation, and (3) in enhancing this system, it is necessary on finding the newest technology that probably implemented, such as technology that can calculate how many iron steel rod in a bundle only by uploading an image or technology that can provide calculation on how to stacking cargoes one by one in a container.

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