IMPROVEMENT OF INFORMATION FLOW FOR RAIL FREIGHT TRANSPORTATION

Nattakit Yuduang
Department of Industrial Engineering, Faculty of Engineering, Mahidol University, Nakhon Pathom, Thailand, E-mail: nuttakit33@gmail.com

Jirapan Liangrokapart*
Department of Industrial Engineering, Faculty of Engineering, Mahidol University, Nakhon Pathom, Thailand, E-mail: jirapan.lia@mahidol.ac.th *Corresponding author.

ABSTRACT

Rail freight transportation is one of important modes for freight transport as it is good for bulk materials, agricultural products and containers. In order to save logistics and transportation cost, many companies select to transport their products by rail. However, in Thailand the rail freight is only 1 percent of all transportation modes which majority is the road transport, followed by water transport. One reason that companies do not use rail freight is the limitation to track or trace the shipments. Companies may not know where the shipments are and when they will arrive at the destination. This is due to the information do not flow smoothly among all parties in the supply chain. Therefore, this research is intended to illustrate information flow along the supply chain to unveil the missing link of the information. Then, suggestions for filling the gaps will be made so that traceability can be expected. The case of State Railway of Thailand (SRT) practice is used to reflect the problems and suggest solutions for improvement.

Keywords: rail freight transportation, traceability, information flow, data modelling

1. INTRODUCTION

Rail freight transportation takes a crucial part in the goods distribution. In Thailand, truck transportation is more popular than rail freight transportation. According to the Ministry of Transport (2016) and Thailand Logistics Report (2015), Thailand's domestic freight utilizing truck transportation is 80.86 percentage while rail freight transportation is 1.9 percentage. Freight forwarders believe punctuality, information, and technology in rail freight transportation is unreliability and inefficiency in comparison to truck transportation.

This study proposes the designs of traceability system for Thailand's rail freight transportation. The traceability system objectives aim to track the goods and activities in the rail freight transportation in real-time, including a shipping activities, a goods' locations, a vehicle's positions, and a carrier's details. The designing tools are consisting of a use-case diagram, process flow diagram, a sequence diagram, and an entity-relationship (ER) diagram. The use-case diagram illustrates the actors and system functions with the relation between actors and functions. The IDEF shows the related activities in rail freight transportation with inputs, controls, and outputs. The sequence diagram presents the steps of information exchange and acknowledgment between tracking activities. The ER diagram presents data attributes and association of the data.

The remainder of the paper first outlines rail freight transportation in Thailand. The subsequent sections outline the designing of the traceability system. The paper ends with a

conclusion.

2. RAIL FREIGHT TRANSPORTATION AT STATE RAILWAY OF THAILAND

State Railway of Thailand (SRT) consists of three divisions which are responsible for rail freight transportation based on the different types of goods transported. Three divisions include bulk and general freight division, industrial freight division, and container freight division. Rail freight transportation is a complex system because there are several relevant parties, namely consigners, consignees, and different internal departments of the State Railway of Thailand.

This research divided goods transportation into two networks, including Intermodal, and Modal transportation. Intermodal Transportation is the movement of goods in multiple stages of transportation using two or more modes of carriers during the transport between consignor and consignee. For example, the consignor transport goods by truck from their warehouse to the train station that SRT will take responsibility. SRT proceeds goods by receiving, loading, and transporting goods to the destination train station. At goods arrival time, the consignee will receive goods and carries goods by truck to their warehouse. Modal Transportation is the movement of goods using one mode carrier during the transport between consignor and consignee.

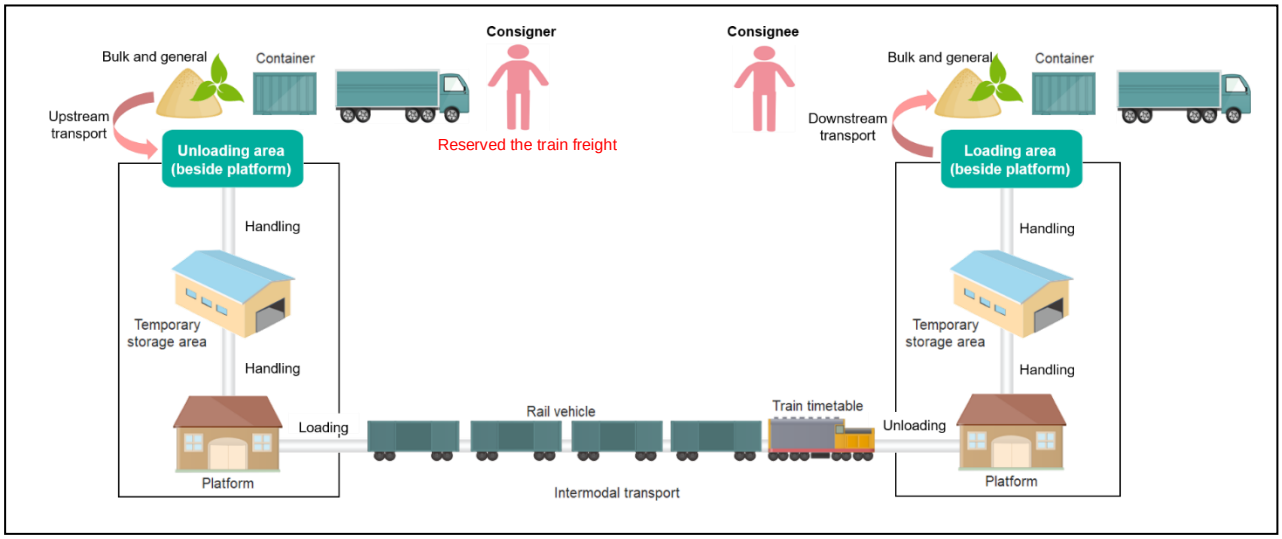

Figure 1 Rail Freight Transportation Process

Figure 1 shows the traceability information exchange starts from reserving the train freight by the consignor and check the status of available freight that provide by SRT. If the freight is available, the reserve's confirmation and the payment details are display to the consignor. At the scheduled time, the consignor transports the goods to the train station while SRT updates freight status. This information on goods' transportation will notify to the consignee. At the arrival time, the consignee going to the train station for unloading the goods and transports the goods to their warehouse or destination location, while SRT updates the freight status on the system. SRT is responsible for managing both internal processes and external entities, which are relation with rail transportation, for increasing reliability and improving stability.

3. DESIGN OF TRACEABILITY SYSTEM

Kumar A., et al. (2017) andThakur and Hurburgh (2009) discussed the communication among rail freight transportation entities using traceability for increasing their interoperability performance.

The first designing step is using a use-case diagram to shows the important actors and functions of

the traceability system. Figure 2 shows the traceability system and responsible actors in the form of the use-case diagram. The system contains three main functions consist of user authentication, user information, and goods tracking.

SRT manages user authentication by add new users, create a user account, update user information, or update account status. The users of this system are the consignor(s) and the consignee(s) who use the login account providing from SRT for using the traceability system. User information is the function that users used to add, edit, or view their information. Goods tracking is the function that users used to update and to track the goods' current status.

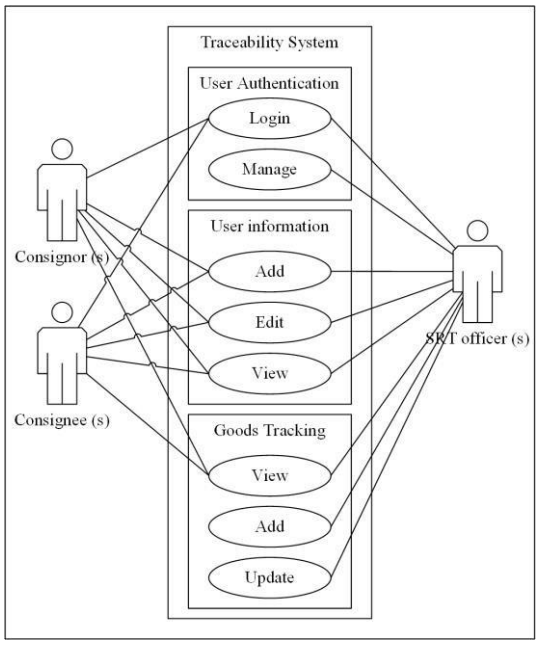

Figure 2 Traceability System Use-Case Diagram

There are three types of information:

1. Goods information includes name, types, quantity, weight, dimensions, etc.
2. Process information includes the date, freight train number, truck number, container number, train station, train station position, tracking number, types of services, etc. The data records every transaction occurred in the transportation activities.
3. User information includes company name, responsible person, phone number, address, system account, user credit, etc.

This study gives precedence to information privacy that the system design separates into two levels, including private information and shareable information. Private information is the individual user data, e.g., product price, freight discount information, etc. Shareable information is the data that display in public sites, e.g., goods location, current process, etc.

4. TRACEABILITY PROCESSES

Thakur (2009) and Kumer (2017) researches and develops the system that is using for tracking and tracing in the grain and textile industry. The process flow is normally used to structure and analyst business processes. Figure 3 shows the overview process flow of traceability system which explained as follow; the rectangle shape is the functions of traceability system that perform by the users, the diamond shape is a decision that perform by the system, the arrow

describes the connection or flow to the next step of the selection function.

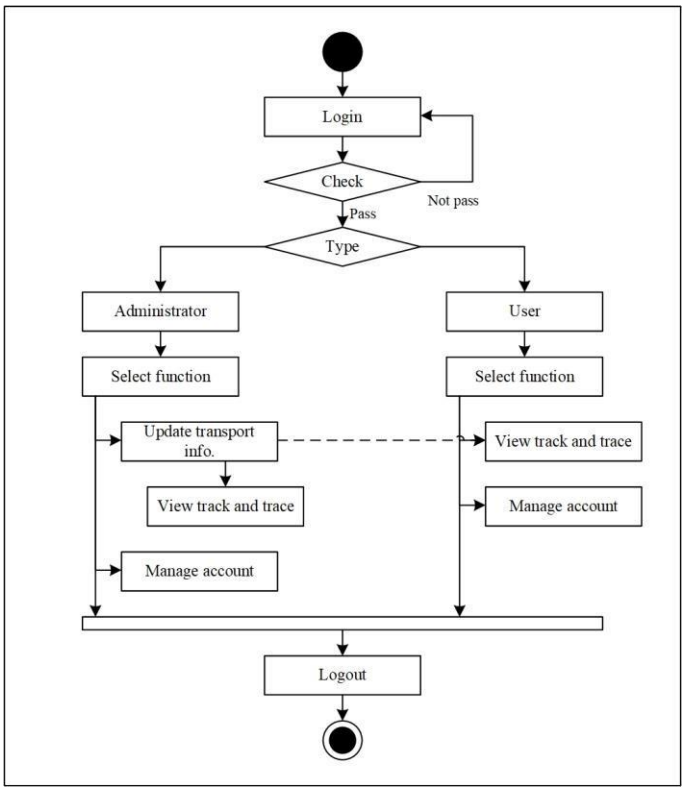

Figure 3 Overview Traceability System Flow

The system starts with a user is login into the system, then the system is checking the permission of the user. If a user has authorized the system will forward the user to the system's main function else, the system will forward the user back to the login function. The system will check the authorized user for the identification of a type of user. There are two types of users, including administration, and user.

Administration account contains three main functions consisting of;

1) Update transportation information, system administrator uses this function to provide necessary information for the tracking and tracing to the consignors or consignees;
2) View track and trace, this function provides an overview of rail freight details, and that SRT is handling at the current period. SRT can use this function to manage freight capacity and utilization;
3) Account management, this function used to manage all user account in the system.

User account has two main functions consisting of;

1) View track and trace, the function provides information about the goods transport that consignor and consignee received the authorized to view, including goods location, the current activity, estimate time to arrival, and remark;
2) Account management, this function gives the user to manage their information

The last function is sign-out that the user uses for logging out of the system when they finish their job.

5. ENTITY-RELATIONSHIP (ER) AND INFORMATION EXCHANGE

For traceability, the information needed to be shared among actors include consignor, consignee, and SRT. The ability to provide an initial view of traceability is not including time dependency input, consequently that resulting the system cannot perform the information process flow (Dorador and Young, 2000). The system requires the sequential of processes and information exchange of numerous activities for tracking and display the information at various points of activities in the rail freight transportation. Figure 4 shows the designed sequence diagram and the relation point of activities in this research.

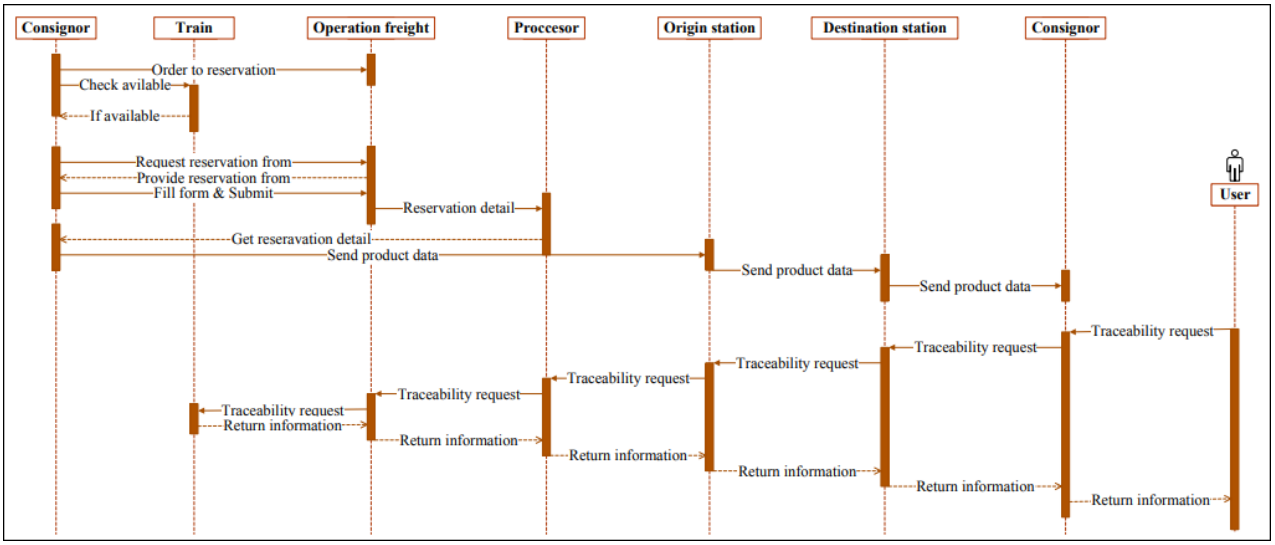

Figure 4. UML sequence diagram of information exchange among the actors

The exchanging message and data through the sequential checkpoint in the diagram are using in design the ER diagram of the traceability system. The results of design ER diagram shown in Figure 5.

6. DEVELOPMENT OF THE SYSTEM

The designed system will be developing using open-source software in both database system and coding language. The system will develop into a web-based application that suitable and adjustable for or platform of operating system. The database system is MySQL server that is a relational model database server. The coding language is PHP that is a widely used for web development and can be embedded into HTML. PHP will be used in both system interface and database connection. The system contains front-end for users and back-end foradministrator.

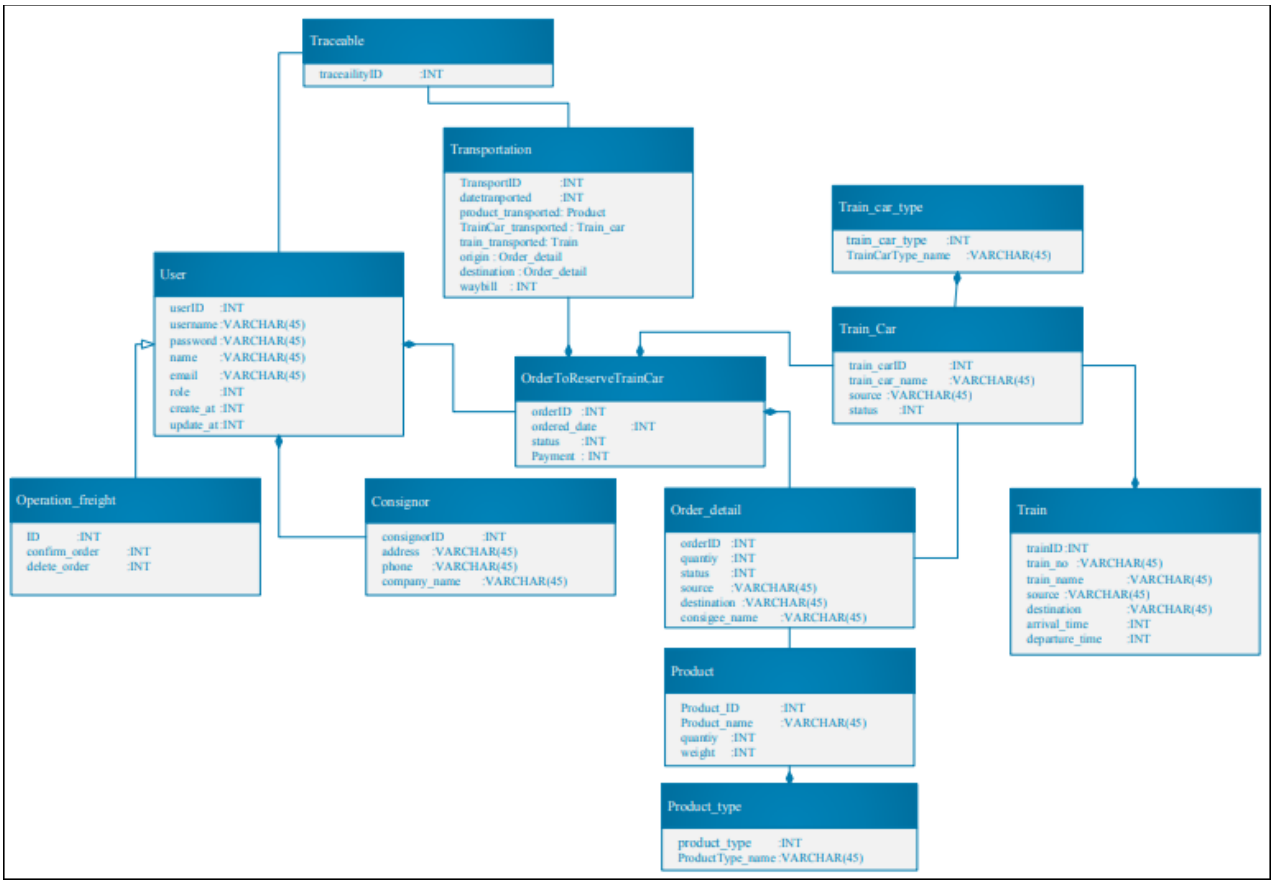

Figure 5. A part of entity relationship model for rail freight transport network

7. CONCLUSION

Rail freight transportation is one of the important modes of freight transport. Although Thai's freight transport majority depends on road transport, rail freight transportation is becoming increasingly popular. The tracking and tracing system is an important part that will support the growth of rail freight transportation development. The system supports the information flow smoothly among all parties in the supply chain. Therefore, this research is intended to illustrate information flow along the supply chain to unveil the missing link of the information. Then, suggestions for filling the gaps will be made so that traceability can be expected. The case of the State Railway of Thailand (SRT) practice is used to reflect the problems and suggest solutions for improvement.

8. ACNOWLEDGEMENT

The authors gratefully acknowledge the financial support provided by National Research Council of Thailand (NRCT) under the program Research Scholarships for Graduate Students 2018 for the Thai master degree program research.

9. REFERENCES

Angsana, S., (2000). Processing of State Railway of Thailand (SRT). *Ph.D. Thesis* National Institute of Development Administration, Thailand.

Behiri, W., Belmokhtar, B. S., Chu, C., (2018). Urban Freight Transport Using Passenger Rail Network: Scientific Issues and Quantitative Analysis. *Transportation Research Part E: Logistics and Transportation Review,* 115, 227 – 245.

Dorador, J. M., Young, R. I. M., (2000) Application of IDEF0, IDEF3 and UML methodologies in the creation of information models, *Int. J. Comput. Integr. Mfg.*, 13 (5), 430 – 445.

Hu, J., Zhang, X., Moga, L. M., Neculita, M., (2013). Modeling and implementation of the vegetable supply chain traceability system. *Food Control*. 30, 341 – 353.

Kumar, V., Hallqvist, C., Ekwall, D., (2017). Developing a Framework for Traceability Implementation in the Textile Supply Chain. *Systems* 5 (2), 33 – 53.

Macário, R., Reis, V., (2008) Architecture of an information system for an intermodal transport service, *Engineering Management Conference, 2008. IEMC Europe 2008. IEEE International.*

Mirzabeiki, V., (2013). An overview of freight intelligent transportation systems, *Int. J. Logist. System Manag.*, 14 (4), 473 – 489.

Mirzabeiki, V., Holmström, J., Sjöholm, P., (2012) Aligning Organisational Interests in Designing Rail-Wagon Tracking. *Operations Management Research.* 5 (3-4), 101–115.

Office of the National Economic and Social Development Board, (2015). Thailand's Logistics Report 2015.

Thakur, M., Hurburgh, C. R., (2009). Framework for implementing traceability system in the bulk grain supply chain. *J. Food Eng*. 95, 617 – 626.

Vanichkobchinda, P., (2007). Improving Railway Freight Transportation System: A Key Step in Realising National Intermodal Development Policy. *Proceedings of the 2nd International Conference on Operations and Supply Chain Management*, Bangkok, Thailand, 313 – 319.

Weerawat, W., (2015) Rail Freight Transport. Mahidol University, Nakhonpathom, Thailand.