

City Logistics for Mega City: A Conceptual Model

(Case Study: DKI Jakarta)

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Abstract—As one of the mega cities in the world, to meet the needs of its population, DKI Jakarta not only faces logistics problem which is low availability, but also transportation problem which is traffic congestion. Those problems show that DKI Jakarta needs an urban logistics system that is not only effective and efficient, but also that does not add its transportation problem. Urban logistics system that takes into account traffic congestion is known as city logistics. Therefore, to address these needs, city logistics needs to be developed in DKI Jakarta. The importance of considering traffic congestion in developing urban logistics systems is due to traffic conditions that are getting worse lately in many cities in the world. This research is trying to develop city logistics that is able to solve low availability and traffic congestion problems as well. City logistics that is able to solve the problems has never been developed before. To develop city logistics for the problems, it needs to determine city logistics system, fundamental concept of city logistics, and initiatives of city logistics that are able to solve the problems.

Keywords—city logistics; low availability; traffic congestion

I. INTRODUCTION

Urban areas are the areas with high population levels. The high population levels contribute to the high demand for goods and services that must be met [1]. As one of the mega cities in the world, the high demand for goods and services are also experienced by DKI Jakarta. DKI Jakarta has an area of 653.63 km² and population of 10,187,595 people. The rate of population growth in the period of 2000-2010 is 1.42% per year. During the day, the population of DKI Jakarta can reach about 12.1 million people [2].

As one of the ways to meet the needs of its population in consumption of food, The Government of DKI Jakarta provides two Wholesale Markets in DKI Jakarta, namely Kramat Jati Market and Cipinang Market. Both of Wholesale Markets are supplied from outside of DKI Jakarta as well as

imports. The Suppliers along with the percentage of the supplies are North Sumatera (13.42%), West Sumatera (1.61%), Jambi (2.81%), South Sumatera (0.57%), Lampung (16.67%), West Java (3.57%), Center Java (16.72%), DI Yogyakarta (0.99%), East Java (12.96%), Banten (0.70%), Bali (8.84%), West Kalimantan (4.29%) and imports (16.84%). Both of Wholesale Markets then supply 165 Traditional Markets that are scattered in DKI Jakarta where DKI Jakarta's population can buy the consumption of food [3].

One hundred and sixty five Traditional Markets are scattered in DKI Jakarta, where 29 markets are located in South Jakarta, 42 markets are located in East Jakarta, 32 markets are located in Central Jakarta, 36 markets are located in West Jakarta, and 26 markets are located in North Jakarta. According to [4], the market share of traditional market in Indonesia is 61.8%. From these data, it can be concluded roughly that 61.8% of consumption of food in DKI Jakarta is supplied by those 165 traditional markets, or about 1,524 tons per day. When they are divided by municipalities, then as much as 320 tons (21%) are demand of South Jakarta, 439 tons (29%) are demand of East Jakarta, 169 tons (11%) are demand of Central Jakarta, 339 tons (22%) are demand of West Jakarta, and 257 tons (17%) are demand of North Jakarta [3].

To deliver each demand to each municipality, it takes a number of vehicles. Using the assumption that vehicle used is box car [5] with a capacity of 800 kg, it takes about 1,905 vehicles daily, where 400 vehicles deliver goods to South Jakarta, 549 vehicles to East Jakarta, 211 vehicles to Central Jakarta, 424 vehicles to West Jakarta, and 322 vehicles to the North Jakarta.

According to [3], both of Wholesale Markets, in fact, have not been able to meet the needs of DKI Jakarta's population effectively and efficiently. This is characterized by low

availability and traffic congestion caused. The symptoms are caused by both existing Wholesale Markets that are not functioning as they should be in the food supply chain of DKI Jakarta. Some Suppliers which come from outside of DKI Jakarta as well as imports, do not supply Wholesale Markets, but directly supply the customers, both non-household customers (hotels, restaurants, etc.) and household customers in DKI Jakarta. This causes the food supply chain of DKI Jakarta become complicated (Fig. 1).

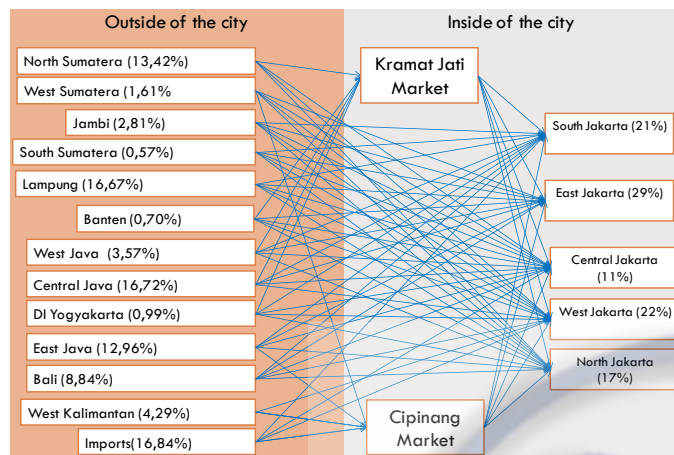


Fig. 1. Real system of food supply chain of DKI Jakarta

That complicated supply chain also causes traffic congestion. This is because the number of vehicles required increase when each Supplier of DKI Jakarta can directly deliver goods to each point of demand in DKI Jakarta. That number of vehicles ultimately gives impact on traffic congestion. The illustration of urban logistics system of DKI Jakarta can be seen in Fig. 2.



Fig. 2. Illustration of urban logistics system of DKI Jakarta

Low availability symptom indicates that DKI Jakarta faces logistics problem, while traffic congestion symptom indicates that DKI Jakarta faces transportation problem. Logistics problem and transportation problem show that DKI Jakarta needs urban logistics system that is not only effective and

efficient in terms of logistics costs, but also that does not add transportation problem of DKI Jakarta in terms of traffic congestion. Urban logistics system that takes into account traffic congestion is known as city logistics [6]. Therefore, to address these needs, city logistics needs to be developed in DKI Jakarta.

II. BACKGROUND OF LITERATURE

The idea of city logistics is to develop urban logistics system that is effective and efficient as well as environmentally friendly [6]. The definition of city logistics according to [7] is “the process for totally optimising the logistics and transport activities by private companies with the support of advanced information systems in urban areas considering the traffic environment, its congestion, safety and energy savings within the framework of a market economy”.

According to [8], there are five initiatives of city logistics. They are advanced information systems, cooperative freight transportation systems, public logistics terminals, load factor controls, and underground freight transport systems. Each city develops city logistics in accordance with the problems and the conditions of the city. According to [9] there are four problems related to the development of city logistics. They are economic problem, traffic congestion, environmental problem, and energy consumption. This can be seen from some researches related to city logistics that have been done.

Reference [10] developed city logistics in City of Hague (Netherlands) in the form of public logistics terminal initiative through the use of UCC (urban consolidation centers) related to traffic congestion and environmental problems. Reference [11] developed city logistics in the West Pomeranian Region (Poland) in the form of public logistics terminal initiative through the use of UCC related to economic problem. Similarly to [10], [12] also developed city logistics in the form of public logistics terminal initiative through the use of UCC in the City of Belo Horizonte and Fortaleza city (Brazil) related to traffic congestion and environmental problems.

Another research that also developed city logistics in the form of public logistics terminal initiative is [13] that developed city logistics in the area of Kyoto-Osaka (Japan) related to economy, environment, traffic congestion, and energy consumption problems. Reference [14] also developed city logistics in the form of public logistics terminal initiative through the use of UCC in the City of Rome (Italy) related to traffic congestion and environmental problems. Reference [15] developed city logistics in the city of L'Hospitalet de Llobregat (Barcelona) in the form of cooperative freight transportation system initiative through cooperation between carriers and the public logistics terminal through the use of UCC related to traffic congestion and environmental problems.

There is also research conducted by [16] that developed city logistics in Soria City and City of Madrid (Spain) in the form of advanced information systems initiative through the use of GPS (Global Positioning System) to improve delivery performance related to traffic congestion and environmental problems. Reference [17] developed city logistics in the City of London (England) in the form of public logistics terminal

initiative through the use of UCC and clean vehicles related to traffic congestion and environmental problems.

In addition, there are also researches that are not included in the five of the city logistics initiatives that have been mentioned. There is a research conducted by [18] that developed the city logistics in Ile-de-France Region (France) through the use of waterways and rail related to traffic congestion and environmental problems. Rerence [19] developed city logistics in City of Bologna (Italy) through zoning of loading/unloading of goods vehicles that includes size, number, and location related to environmental problems.

From researches that have been described previously, it can be seen that there is no research that develops city logistics related to logistics problem which is low availability and transportation problem which is traffic congestion. Therefore, this research will further develop city logistics that is able to solve both of the problems.

III. METHODOLOGY

The framework to conduct this reasearch can be seen in Fig. 3. References that will be used to develop city logistics in this research are [20], [21], and [8].

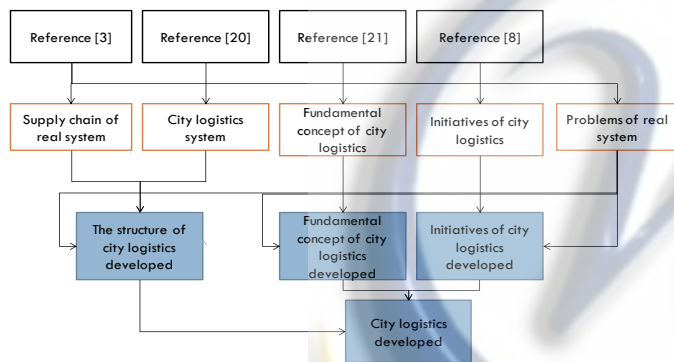


Fig. 3. The framework of the research

According to [20], there are two systems of city logistics. They are single-tier city logistics system and two-tier city logistics system. City logistics system that will be developed in this research will be adjusted with the entities in the supply chain and the problems of the real system. Fundamental concept of city logistics that will be used in this research will be same with fundamental concept according to [21]. They are consolidation and coordination activities. Initiatives of city logistics from [8] that will be used in this research will be adjusted with the problems that will be solved in this research.

IV. DEVELOPING OF CITY LOGISTICS

This section will describe the developing of city logistics that can solve low availability and traffic congestion problems as well.

A. City Logistics System

City logistics system is related to the structure of city logistics. According to [20], there are two city logistics system. The first one is single-tier city logistics system that

consists of three entities in the supply chain. They are point of supply, logistics facility, and point of demand (Fig. 4).

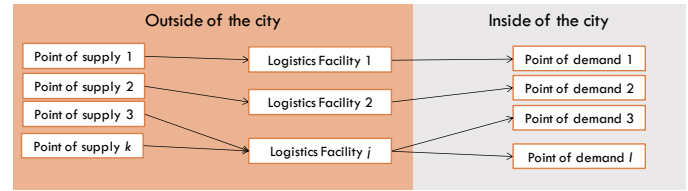


Fig. 4. Single-tier city logistics system

The second one is two-tier city logistics system that consists of four entities in the supply chain. They are point of supply, logistics facility, satellite platforms, and point of demand (Fig. 5).

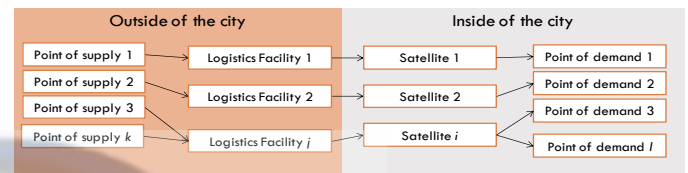


Fig. 5. Two-tier city logistics system

In the supply chain of the real system, there are three entities involved. They are Suppliers, Wholesale Markets and Traditional Markets. Therefore, city logistics system that will be developed in this research is one-tier city logistics system which also consists of three entities, namely point of supply, logistics facility, and the point of demand. City logistics that will be developed in this research will cover the whole city, so the point of demand is not only the Traditional Markets, but also the modern retails. Point of demand is then called as Retail Markets.

The term of Wholesale Markets are also not used anymore in this research. The term of Wholesale Markets are then replaced with UCCs. UCCs are logistics facilities located outside of the city serving the needs of the whole city where consolidation and coordination activities take place. Since UCCs are located outside of the city, then the locations of Wholesale Markets also can not be used. New locations for UCCs need to be determined where they must be located outside of the city. Therefore the entities involved in city logistics developed in this research are Suppliers, UCCs, and Retail Markets (Fig. 6).

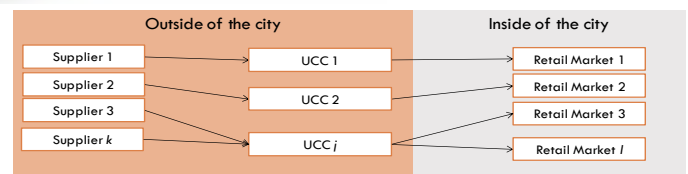


Fig. 6. The structure of city logistics developed

B. Fundamental Concept of City Logistics

According to [21], fundamental concept of city logistics is consolidation and coordination activities. Both of these activities take place in UCCs and they use to solve the

problems in this research. Consolidation activity is used to solve logistics problem which is low availability. Low availability indicates low service levels. One of the ways to improve service levels is through inventory control [22]. Therefore, in this research consolidation activity is related to consolidation of goods from Suppliers in UCCs, distribution of goods from UCCs to Retail Markets, and inventory control in three entities involved which are Suppliers, UCCs, and Retail Markets.

Coordination activity is then used to solve transportation problem which is traffic congestion. According to [23], reduction in the number of vehicles can reduce traffic congestion. The reduction in the number of vehicles is caused by the use of vehicles together in UCCs. It is known as cooperative freight transportation system. This can be seen through the evaluation model of traffic congestion developed by [24].

Due to the use of vehicles together in UCCs, then coordination of transportation activities are required. Coordination of transportation activities include delivery routes, vehicles used, and the sequence of customers to be served or in short they are called as vehicle routing [25]. Besides that, transportation activities take place in urban area where there are more than one of road networks that connect UCCs and Retail Markets. Therefore, route assignment needs to be determined too [26]. So, in this research coordination activity is related to determination of vehicle routing and route assignment from UCCs to the Retail Markets.

C. Initiatives of City Logistics

It can be seen from previous discussion that city logistics developed in this research uses public logistics terminal initiative through the use of UCCs and cooperative freight transportation system initiative through the use of vehicles together. Both of the initiatives are used because they are believed to be able to solve logistics problem which is low availability and transportation problem which is traffic congestion.

V. CITY LOGISTICS DEVELOPED

The summary of city logistics developed in this research can be seen in Table 1.

TABLE I. THE SUMMARY OF CITY LOGISTICS DEVELOPED

Parts of city logistics	City logistics developed
City logistics system	Single-tire city logistics system
Fundamental concept of city logistics	Consolidation and coordination
Initiatives of city logistics	Public logistics terminal and cooperative freight transportation system

The supply chain of city logistics developed in this research can be seen in Fig. 7. From the physical point of view, Suppliers supply the goods to UCCs. One Supplier only can supply one UCC and Supplier only can supply UCC that corresponds with Supplier's origin. For example, Supplier that comes from the west only can supply UCC that is located in

the west. After the goods arrive in UCCs, consolidation and coordination activities are performed. It includes consolidation of goods from Suppliers in UCCs, distribution of goods from UCCs to Retail Markets, determination of vehicle route and route assignment from UCCs to the Retail Markets. UCCs then supply Retail Markets. One Retail Market only can be supplied by one UCC and it must be from UCC that is relatively close to Retail Market.

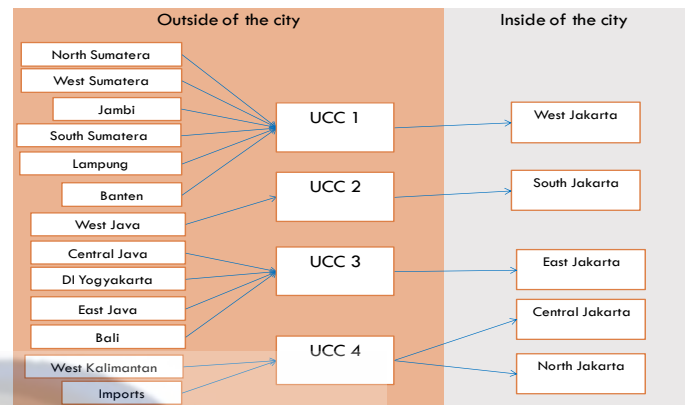


Fig. 7. Supply chain of city logistics developed

These arrangements are intended so that the supply chain become simple. A simple supply chain is an effective and efficient supply chain. This simple supply chain is also intended to reduce traffic congestion. Since Suppliers can not directly meet Retail Markets or any customers in the city, then it reduces the number of vehicles that enter the city. The reduction of the number of vehicles can reduce traffic congestion.

From the information point of view, it starts with demands from customers to Retail Markets. These information are then continued to UCCs and to Suppliers. Based on these information, one of consolidation activity is performed which is inventory control. Inventory control is performed in three entities involved in the supply chain to achieve high service levels. The illustration of city logistics developed can be seen in Fig. 8.

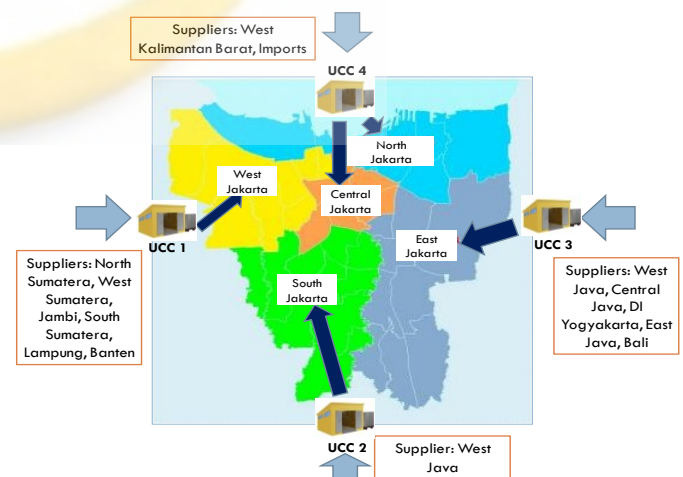


Fig. 8. Illustration of city logistics developed

VI. CONCLUSION

This research develops city logistics that is able to solve low availability and traffic congestion problems. City logistics that is able to solve the problems has never been developed before. From the discussion, city logistics system used for city logistics developed is single-tier city logistics system, fundamental concept of city logistics used is consolidation and coordination, and initiatives of city logistics used are public logistics terminal and cooperative freight transportation system.

City logistics developed in this research is a conceptual model. Therefore, it gives challenge to enhance this research become operational model for future work. This research also has some limitations. City logistics developed in this research only examines the flow of goods that enter the city and the goods examined in this research are only fruits and vegetables.

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