Integration of Smart Logistic and Crowd shipping for Sustainable City Logistic

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Abstract

The flow of urbanization is increasing every year. This increase in urbanization has led to increased e-commerce users in urban areas involving the movement of goods from sellers to buyers, called logistic activities. It means urbanization will cause an increase in the number of vehicles passing through urban areas. The number of passing vehicles increases, but the road capacity remains, which causes congestion. Congestion will cause inefficiency in fuel and travel time. One of the solutions to this problem is crowd-shipping. Crowd-shipping reduces the number of vehicles by involving occasional drivers in delivery activities to minimize courier delivery activities. This study provides a literature review and integration framework between crowd-shipping and smart logistics. The literature review defines the research clusters of crowd-shipping, the challenge of implementing crowd-shipping according to previous research, and the measurement of crowd-shipping success. This research was conducted using co-occurrence analysis on 949 articles containing the keyword crowd-shipping to generate the research cluster. This paper categorizes it into four research clusters, i.e., the crowd-shipping actor, the basis of crowd-shipping, the requirement to implement crowd-shipping, and urban mobility. The integration framework of crowd-shipping and smart logistics is developed by comparing the crowd-shipping process and its requirement with the smart logistics components. The result found that all of the requirements of the crowd-shipping process can be fulfilled by smart logistics. The literature review results in six challenges and ten parameter success measures of crowd-shipping implementation.

Keywords
Crowd-shipping, Smart logistics, Integration framework, Literature review.

1. Introduction
Nowadays most of peoples are preferring to live in urban areas than in rural areas. This phenomenon is often referred to as urbanization. More than half of the World's population now lives in urban areas (Chourabi et al., 2014). In 2050, around of 70% population in the world will live in urbans and neighboring regions (United nations, 2015). The desire to improve the quality of life (Yi et al., 2021), the need for education, and the availability of employment opportunities (Hofmann et al., 2013) are the major factors that encourage most people to urbanize. The increase in the number of urban residents is also followed by an increase in several problems (Han et al., 2014). The mass migration to the cities will increase the number of densely populated areas, further complicating urban mobility and logistics (OECD, 2012). Rapid urbanization also harms the environment. Although cities occupy 2% of the planet, they already account for 60% to 80% of energy consumption and 75% of carbon dioxide emissions. Although goods transport is responsible for 14% of the vehicle kilometers, 19% of energy use, and 21% of CO2 emissions in urban areas, city logistics needs are often neglected in urban planning (Nocerino et al., 2016). The rapid growth in the use of e-commerce in urban areas has contributed to the number of logistics activities, especially for last mile deliveries. The growth of the used of e-commerce caused an increase of goods transportation in the city center, impacting traffic congestion, the environment and energy consumption. (Correira, 2022). There is no city can work well as long as the logistics activities inside it are inefficient (Kauf, 2016).

There are several kinds of inefficiencies in logistics activities, such as inefficiency in fuel use, inefficiency in travel routes, inefficiency in vehicle capacity utilization, and so on. Inefficient logistics activities have an impact on poor service for public transportation, traffic congestion, death or disability due to pollution, and scarcity of resources in the future (Miranda, 2012). Traffic density is the result of inefficiency in the utilization of vehicle capacity where all

logistics activities run separately from each other. When there is travel activity from point A to point B, then there will be 1 logistics activity by 1 fleet. Meanwhile, at the same time there may also be activities for delivering goods through the same road and destination area using 1 different fleet, so there will be 2 vehicles traveling to the same location. Thus, it is necessary to apply concepts that facilitate the integration process between these logistics activities.

There are several solutions for the problems above, one of which is by involving ordinary citizens to take on the role of couriers and creating a new logistics network for the distribution of small goods, this concept called as crowd shipping (Mckinnon, 2016). Crowd shipping involves people who have traveled to be deposited with goods which have same delivery regions. Crowd shipping makes use of an underused asset, in this case is the transport capacity of private drivers (Boysen, 2022). The purpose of implementing crowd shipping is to reduce shipping costs, congestion, and environmental impacts (Oliveira, 2019). Crowd shipping can run well if there is a good flow of information such as the availability of drivers who will send goods, the location to be addressed, the sender's position, delivery destination, fees, etc. To be able to ensure that information is received from both the driver's side and the shipper's side, it is necessary to have the role of technology that is integrated with crowd shipping logistics activities. Efforts to involve the role of technology in logistics activities are known as smart logistics.

“Smart Logistics” is a dynamic concept in the form of a series of activities that allow all users to quickly react to the environment, both micro and macro. “Smart Logistics” is an intelligent combination of technology, administration, and human activities that enables one to predict problems and minimize logistical impacts in a given area, coordinate resources to achieve goals effectively, and remove communication challenges between the supply chain elements involved (Korczak et al., 2018). “Smart Logistics” basically aims to efficiently align planning and scheduling, Information and Communication Technology, people, and government policy making (Jabeur, 2017). The smart logistics concept that is integrated with crowd shipping is expected to ensure that information between crowd shipping actors runs smoothly and is received in real-time.

There are several previous studies related to crowd shipping. Karakikes (2022) investigated the use of public transport for the deployment of crowd shipping services, as well as the installation of smart lockers to be strategically placed in high demand areas, to enable final recipients to receive their packages with flexibility and low cost compared to home delivery with a Greek city as the object. study. Zehtabian (2022) investigated how to estimate the time it takes for drivers to pick up and deliver goods with the object of research in the Danish city. Punnel (2019) explores the differences between crowd shippers and non-crowd shippers in America. The results show that: (i) crowd shipping is more common among young men who work full time, (ii) urban areas prefer to deploy services, and (iii) crowd shippers are willing to do medium-distance shipping. Paloheimo (2015) investigated whether crowdshipping has sustainability benefits based on a case study of sending books from a library in the city of Jyväskyl, Finland. In this case, the results show that the environmental benefits of crowd shipping are directly proportional to the distance saved. In addition, based on indicative extrapolation based on trials developed in the study, it was concluded that crowdsourced shipping could save an average of 1.6 km/delivery, and if all deliveries were made by cyclists, the savings would increase to 2.5 km/delivery.

However, previous research has focused on methods that can be used in implementing crowd shipping for specific cases, such as budget determination, allocation of locker facilities, crowd shipping actors, and so on. There has been no research related to crowd shipping discussion clusters, even though knowing what clusters of factors are discussed in crowd shipping will make it easier for readers to understand the crowd shipping concept more deeply. In addition, there are still few studies that discuss the integration of crowd shipping with smart logistics. The obstacles and measurement of the success of implementing crowd shipping are still not widely discussed.

1.1 Objectives

Based on that research gap, this research focuses on answering the following 3 research questions:

RQ1. What are the research cluster in the crowd shipping?
RQ2. How is the integration between crowd shipping and smart logistic?
RQ3. What are the challenges to implementing crowd shipping and how to measure its success?
The first research question is to visually describe what factors make up crowd shipping, by showing the important factors in crowd shipping, the basic concepts of crowd shipping will be easier to understand. Whereas the second research question is to show how the integration model between crowd shipping and smart logistics for supporting

crowd shipping application. The third research question is to show, what is the challenges in implementing crowd shipping from previous research and showing indicator to assess the successful of implementing crowd shipping.

2. Literature Review

Integration is defined as mixing two or more concept that have different role. It seems like crowd shipping and smart logistic, both of them are the concept in logistic, but their concept is totally different. Crowd shipping is a collaborative strategy that distributes delivery tasks to a mass of actors that act as ordinary couriers, aiming at reducing delivery costs and supporting sustainability (Pourrahmani, 2021). In other side, smart logistic is a modern concept in logistic field, smart logistics models use IoT integrated technologies, e.g., radio frequency identification (RFID), wireless sensor network (WSN) and cloud computing, to enhance the traceability and decision supports of logistic processes in real-time speed, high accuracy, and flexibility (Trappey, 2017). Although the two are different, the integration of the two will provide a meaningful breakthrough in the world of logistics. To identify the potential for integration between crowd shipping and smart logistics, a systematic literature review is necessary to be done.

Systematic review is a research method for critically reviewing research with relevant topics, by collecting and analyzing data from another research (Liberati, 2009). The goal of systematic review is to answer research question or hypothesis by identifying all of the evidence that fit to inclusion criteria. Bias can be minimized by using systematic review, so that, the conclusion and decision can be drawn reliably (Moher, 2009). By using systematic review, the constant effect across studies and future studies can be determined. Systematic review can also discover which study level or sample characteristic that impact the study field (Davis et al., 2014). One of the tools that can be used in conducting a systematic literature review is the VOS Viewer.

VOS Viewer is a program used for analyzing all kinds of bibliometric network data, relations between journals or publications, relation between researchers, and co-occurrence relations between scientific terms. Text mining by creating a term map is one of VOS Viewer function. Term map gives information about relation between two or more term. In VOS Viewer, relatedness between terms is determined based on co-occurrences in documents (Eck, 2011). The term map generated by VOS Viewer refer to the cluster of the key term identified and aggregated by VOS Viewer (Ali, 2019). Only documents like scientific publications, patents, or newspaper using English language can be processed by VOS Viewer. In this paper, VOS Viewer is used to identify research clusters related to crowd shipping to determine the characteristics and requirements of crowd shipping.

Cluster analysis is an unsupervised learning technique with a broad application area to divide entities into groups concerning their attributes (Karacan, 2021). In VOS, the words that have inter connection each other are clustered in a group. By clusterring the word, we can easily identify the definition, characteristic, requirement, etc of a concept.

3. Methods

The research begins by defining the problem related to the inefficiency of the logistics process which is made clear by the increase in e-commerce activity. Based on these problems, research is focused on crowd shipping as a solution to these problems. Literature search with the keyword crowd shipping was carried out on the Google Scholar database and produced 949 articles from 2013 until 2022. The entire article was used to map the crowd shipping research cluster using co-occurrence analysis. Furthermore, the collected articles were re-selected based on the criteria in Table 1 for a literature review in order to answer questions related to the concept of crowd shipping, smart logistics, integration of crowd shipping and smart logistics, as well as challenges and measures of crowd shipping success.

Table 1. Selection criteria

Criteria
1. The title of the article contains the word crowd shipping.
2. The article contains the definition, and ways of working of crowd shipping.
3. The article contains the definition of smart logistic.
4. The article contains the challenge of implementing crowd shipping.
5. The article contains a concept to measuring clodhopping's success.

The first criteria are used for defining the research cluster of crowd shipping using co-occurrence analysis. The second and third criteria are used for defining the concept of smart logistic, crowd shipping, integration of them. The fourth

and fifth criteria are used for defining the challenge of implementing crowd shipping and how to measure the success of it.

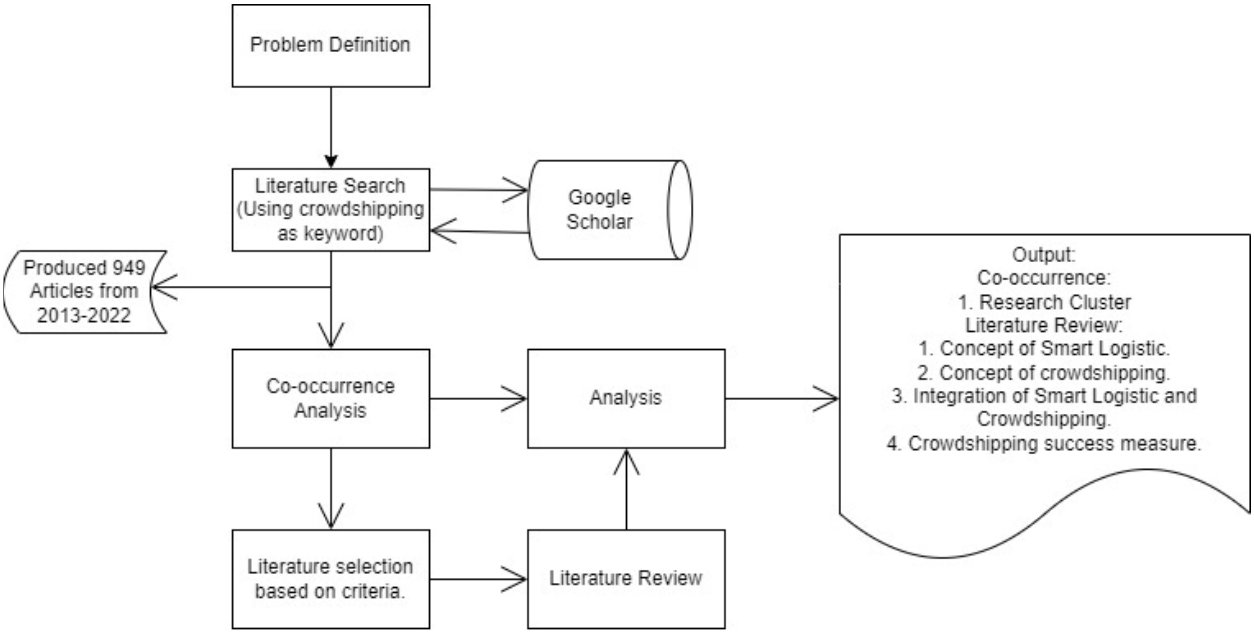


Figure 1. Step of research

4. Data Collection

The data collected in this paper is all of keywords that related to crowd shipping. The keyword is generated from 949 articles from 2013 until 2022 in Google Scholar database. The keywords collection is done using VOSViewer. There are two groups of data collected, the keywords and the occurrence of the keywords. Keywords that shown by VOS Viewer is keywords that have more than five occurrences across all of the included articles. The total keywords collected from all of the articles are 45. This data used for identifying the research cluster of crowd shipping using VOSViewer.(Table 2)

Table 2. Terms related to crowd shipping

Term	Occurances
Agent	18
Approach	47
Case Study	27
City	**48**
Company	**46**
Crowd Shipping Platform	13
Crowdsourced Delivery	13
Destination	16
Driver	29
Drone	12
Emission	18
Last Mile	25
Occasional Driver	27
Online	13

Table 2. Terms related to crowd shipping(Cont.)

Term	Occurances
Performance	24
Platform	**68**
Time Window	13
Vehicle Routing Problem	34
Application	27
Crowd Logistic	24
Crowdsourcing	19
E Commerce	**46**
Field	18
Last Mile Logistic	10
Logistic	**96**
Order	31
Stake Holder	14
Supply Chain	30
Term	14
Trend	22
Urban Freight Transport	18
Willingness	14
Work	23
Communication	23
Network System Triggers	18
Transport Journey	18
Transport Provider Device	18
Transport System	15
Transport User Device	18
Freight	30
Freight Transport	12
Mobility	34
Passenger	21
Potential	29
Urban Area	35

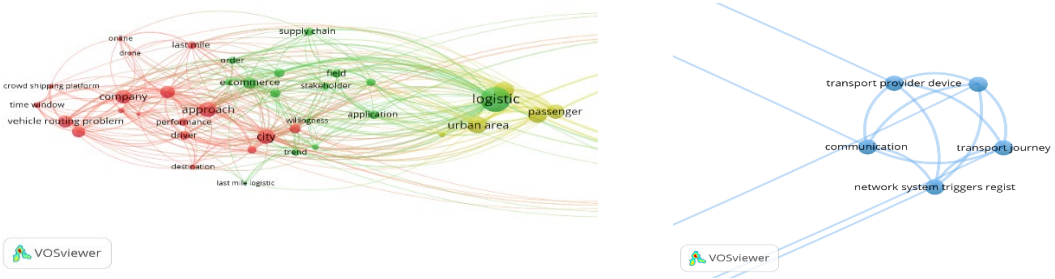
5. Results and Discussion

A systematic literature review was done and resulting 5 main points. The research cluster for defining crowd shipping and its requirements, crowd shipping definition, smart logistic definition, integration between smart logistic and crowd shipping, challenge to implement crowd shipping, and crowd shipping success measure.

5.1 Research Cluster

The research cluster of crowd shipping was analyzed using co-occurrence analysis with “crowd shipping” as keyword. By using co-occurrence analysis, the network of the literature can be evaluated. The output of co-occurrences analysis

is nodes with lines which linking each node. The nodes represented the weight values of keyword that occur in articles. The larger nodes size means the grater values weight of the keyword. The weight divided into three standard values: occurrence, link, and total link strength. Occurrence show multiple appearances in other articles. The value of links represents the number of links associated with a particular keyword compared to others, the link strength represents the number of articles in which the two keywords appeared simultaneously. The total link strength shows the accumulation of values for a particular keyword's link strength (Arvianto, 2021). The data collected in section 4 above was used in co-occurrence analysis and got the result bellow.



(a) (b)

Figure 2. Co-occurrence network: (a) Co-occurrence network for cluster 1, 2, 4. (b) Co-occurrence network for cluster 3.

Based on Figure 2 above, the keywords related to crowd shipping are divided into 4 clusters which are distinguished based on the color of the nodes and the color of the links connecting the nodes. Figure 2 shows that from the 4 clusters formed, there are 3 clusters that are interconnected between nodes in each cluster (part a), while for the other 1 cluster, there are not enough links between nodes (part b). This shows that the keywords in the cluster in part b often appear in the article, but rarely appear together with other keywords in the cluster in part a.

From figure 2 above, the keywords that appear most often related to crowd shipping can be easily analyzed visually. The keywords with the largest nodes are the keywords that appear most often. Figure 2 shows that the word logistics is the most frequently used keyword in crowd shipping related articles. This shows that logistics is an important thing that also needs to be discussed and understood when conducting research related to crowd shipping.

To make it easier to understand the meanings of figure 2 above, the results of clustering, occurrence values, links, and total link strength are shown in the Table 3 below.

Table 3. Research cluster in crowd shipping

Cluster	Keywords	Links	Total Link Strength	Occurances
Cluster 1	Agent	18	29	18
	Approach	29	67	47
	Case Study	24	37	27
	City	27	66	**48**
	Company	23	59	**46**
	Crowd Shipping Platform	10	15	13
	Crowdsourced Delivery	9	12	13
	Destination	12	17	16
	Driver	20	35	29
	Drone	7	8	12
	Emission	14	19	18
	Last Mile	18	29	25
	Occasional Driver	16	45	27

Table 3. Research cluster in crowd shipping

Cluster	Keywords	Links	Total Link Strength	Occurances
Cluster 2	Crowd Logistic	16	34	24
	Crowdsourcing	16	21	19
	E Commerce	23	50	**46**
	Field	15	33	18
	Last Mile Logistic	8	8	10
	Logistic	36	128	**96**
	Order	18	26	31
	Performance	17	27	24
	Stake Holder	19	25	14
	Supply Chain	15	31	30
	Term	17	22	14
	Trend	17	26	22
	Urban Freight Transport	16	27	18
	Willingness	12	13	14
	Work	20	33	23
Cluster 3	Communication	5	82	23
	Network System Triggers	5	82	18
	Transport Journey	5	82	18
	Transport Provider Device	5	82	18
	Transport System	7	82	15
	Transport User Device	5	82	18
	Online	9	13	13
	Platform	26	52	**68**
	Time Window	10	21	13
	Vehicle Routing Problem	17	52	34
	Application	20	35	27
Cluster 4	Freight	19	72	30
	Freight Transport	11	19	12
	Mobility	21	79	34
	Passenger	19	65	21
	Potential	19	69	29
	Urban Area	19	77	35

In Table 3, a link is displayed to show the number of keywords that appear together with certain keywords, for example for the logistics keyword with the highest link value, which is 36, meaning that there are 36 keywords that appear together with the word logistics. This shows that the word logistics is a basic word that needs to be associated with the factors discussed in crowd shipping research. In addition, the occurrence value which is also displayed in the table shows how many articles use related keywords. If in figure 2 we can only know that the word logistics is the word most used by looking at the size of the nodes, in the table the value of the number of articles that use the word logistics can be seen about 96 articles.

The results of clustering using co-occurrence analysis can be seen in table 3. The first cluster contains keywords related to actors in crowd shipping, the second cluster contains keywords related to the context or basis of crowd shipping, the third cluster contains keywords related to the needs of implementing crowd shipping, and the fourth cluster contains keywords related to urban mobility. The four clusters represent areas commonly discussed in previous research related to crowd shipping. The results of clustering using co-occurrence analysis are used as a reference for discussion in this study. The research will focus on discussing the second cluster about the context and basis of crowd shipping. The definition of crowd shipping, smart logistics, integration between crowd shipping and smart logistics, challenges to crowd shipping implementation, and measures of success of crowd shipping implementation will be discussed in this study.

5.2 Crowd shipping

Taniguchi et al (2020) said that E-commerce led to an increase in the need for delivery of small items to offices and homes. Crowd shipping has great potential to reduce the number of delivery vehicles operating in urban areas and reduce operating costs for operators. Crowd shipping will change the activities of people who want to send goods, they no longer have to travel alone to deliver their goods to the destination (Allaviranloo, 2019). In fact, crowd shipping is the most environmentally friendly type of service that can be developed considering this concept avoids someone from making a special trip (Serafini, 2018). Thus, it can be seen that the concept of crowd shipping is an effort to efficiently use vehicles by entrusting the delivery of goods to people who have the same travel destination. In addition to reducing the number of vehicles passing by, the existence of this system also allows delivery to reach the recipient's hands in a short period of time.

To be able to implement crowd shipping, of course, we need people who want to deliver goods and people who want to leave goods. Galkin (2020) in his research related to crowd shipping in Bratislava found that money is one of the main factors that someone wants to participate as a courier in the crowd shipping process. Determination of money or shipping fees can be done by simulating the concept of crowd shipping, from here we can find out the appropriate fee for the shipper (Gdowska, 2018). Crowd shipping success is determined by the number of participants who are members of a system where trust between the sender and the person who delivers the goods plays an important role (Pourrahmani, 2021).

Ghaderi (2022) says that research on crowd shipping is very important for several reasons, namely, crowd shipping has a great opportunity to produce a more environmentally friendly city by utilizing the untapped resources of individuals. Wicaksono et al (2020) in his research states that crowd shipping can be developed by not only involving motorcyclists, but also cyclists. From the research conducted, it is found that the factor of shipping costs, delivery time, and a reduction in CO2 emissions affect consumer perceptions of wanting to use crowd shipping services using bicycles. Giufrida (2021) discusses that crowd shipping can also be implemented by involving students who travel to universities to deliver goods. Ni (2019) said that crowd shipping can be applied to local kiosks to make it easier to reach customers, goods that have been ordered by consumers and have been packaged will be offered to anyone who wants to travel to the same location as the customer/delivery location.
There are several previous studies that define how crowd shipping works.

Table 4**.** How crowd shipping work according to some researcher

No	How Crow shipping Work	Author
1	The crowd shipping process is done by picking up a parcel from an automated smart locker installation located near a public transport stop close to the depot and gets delivered to the final locker installation using intermediate smart lockers near public transport stops. The intermediate pick-ups/deliveries are performed by public transport users. The final recipient is then notified to pick up the parcel from the final locker installation which is just a couple of minutes away on foot.	Karakikes, 2022
2	The drivers that joined in crowd shipping are assigned bundles of customers. To deal with the bundle-to-driver assignment, a bidding system is exploited, in which a company offers a set of bundles, and the drivers raise their bids. These bids depend on features such as the drivers' destination, flexibility in deviating from the shortest path, and willingness to offer service. The literature states that bundles of transportation requests can be built either by sellers or by buyers. However, the number of bundles grows exponentially with the number of customers.	Mancini, 2022

Table 4 shows 2 ways crowd shipping works from different perspectives. Karakikes discusses how crowd shipping works from an operational point of view which is combined with a parcel locker system. Parcel locker stations will be placed in the public vehicle stopping area, goods will be transferred from the original parcel locker to the destination parcel locker which is in the same direction as the public transportation route. Apart from that, the way of shipping transportation described by Mancini is viewed from the point of view of determining bundles for drivers. According to Mancini, it would be fairer if the driver could get a recommendation for a bundle and increase it if it was deemed lacking, while people who want to use the services of a driver to deliver goods can choose their own driver with a bundle that they feel is appropriate.

However, a good flow of information is needed to support the smooth running of crowd shipping. A good flow of information can be built by involving the role of technology into the logistics process, this concept we know as smart logistics.

5.3 Smart Logistic

"Smart Logistics" is a dynamic concept in the form of a series of activities that allow all users to quickly react to the environment, both micro and macro. "Smart Logistics" is an intelligent combination of technology, administration, and human activities that enables one to predict problems and minimize logistical impacts in a given area, coordinate resources to achieve goals effectively, and remove communication challenges between the supply chain elements involved (Korczak, 2018). "Smart Logistics" is an effort to monitor materials, information, and finances as they move through the supply chain, from suppliers, manufacturers, wholesalers, retailers, to consumers who need integration between their chains, as well as improve the accuracy and timeliness of information and reduce costs in operations. logistics and transportation (Tiejun, 2012). "Smart Logistics" basically aims to efficiently align planning and scheduling, Information and Communication Technology, people, and government policy making (Jabeur, 2017). "Smart Logistics" can be defined as the interaction of 3P+I (People, Planning, Policy, and Infrastructure).

According to Woensel (2012) in Korczak's research (2018) Information and Communication Technology is a facilitator for planning and scheduling through providing the right information resources at the right time and place. According to Kirch (2017) "Smart Logistics" is a system for identifying, localizing, and monitoring different object-level conditions in logistics and production processes. Thus, it can be said that "Smart Technology" is a system that integrates the logistics process with the use of technology with the aim of collecting data and information related to the logistics process and finding optimal solutions to problems that arise. According to Uckelmann (2008) the following criteria shall be used to define smart logistics:

1. Smart logistics embraces smart service as well as smart products within logistics,
2. Smart logistics is derived from a technology driven approach, and thereby subject to change,
3. Smart logistics frees humans from (control) activities that can be delegated to smart products and services,
4. Smart logistics are invisible and calm and can therefore be described as transparent,
5. Smart logistics are connected, thus communicating and possibly interacting with their environment,
6. Smart logistics facilitate state-of-the-art data processing (which may include, but do not require software agents),
7. Smart logistics integrates existing logistic technologies, such as material handling systems, and enable these to react and act in a correspondingly smart manner,
8. Smart logistics include state-of-the-art billing, payment or licensing as integral component.

5.4 Integration of Smart Logistic and Crowd shipping

Crowd shipping is a very interesting concept to apply. However, as discussed in the previous chapter, the concept of crowd shipping cannot run independently in an effort to increase the efficiency of the logistics process. The application of technology in the logistics process is needed to ensure that the crowd shipping concept can be applied. Therefore, the concept of integration between crowd shipping and smart logistics is very interesting to identify. The integration model is made by comparing the processing steps in crowd shipping, the requirements for crowd shipping implementation according to the clustering results for the 3rd cluster, as well as smart logistics components stated by Chung (2021) that can meet crowd shipping requirements. The following is an integration model between crowd shipping and smart logistics for the case of the Karakikes and Mancini crowd shipping concept. (Table 5)

Table 5. Integration model between crowd shipping and smart logistic.

Step	Requirement	Smart Logistics Component
1. The sender puts the goods in the smart locker	1. Communication (Step: 3, 6)	Autonomous Vehicle
2. The smart locker provides recommendations for the location of the closest smart locker to the recipient.	2. Network System Triggers (Step: 3, 6)	Block Chain (Req: 1, 3, 5, 6, 8, 11)
	3. Transport Journey (Step: 2, 3, 5)	Artificial Intelligence (Req: 2, 3, 5, 8,10, 11)
3. The smart locker generates information regarding the delivery destination location (Smart locker near the receiver location) in the crowdshipping driver application.	4. Transport Provider Device (Step: 3, 4, 5)	GPS (Req: 3, 4, 5, 6, 8, 10, 11)
	5. Transport System (Step: 2, 3, 4, 5)	Big Data (Req: 3, 5, 8, 10, 11)
	6. Transport User Device (Step: 3, 6)	Machine Learning (Req: 3, 5, 8, 10, 11)
4. Crowdshipping software generates shipping fees for drivers.	7. Online (Step: 2, 3, 4, 5, 6)	
5. Drivers accept the offers and get recommendations for the fastest shipping routes from crowdshipping application.	8. Platform (Step: 2, 3, 4, 5, 6)	
	9. Time Window	
6. The goods are placed in the destination smart locker, and the crowdshipping software generates a qr code to collect the goods for the recipient.	10. Vehicle Routing Problem (Step: 2, 5)	
	11. Application (Step: 2, 3, 4, 5, 6)	

5.5 Challenges to Implementing Crowd shipping

Crowd shipping is an innovation in the logistics sector, especially for the efficiency of the last mile delivery process. A lot of research has been done to implement crowd shipping. Since crowd shipping is a new thing in the logistics area, there are still many obstacles to be found. To be implemented smoothly, various factors including the obstacles must be considered. The challenges from previous research can be used as lessons for the future research. The challenges related to crowd shipping can be seen in Table 6 below.

Table 6. Challenges to implementing crowd shipping

No.	Challenges	Author
1	Accountability and insurance issues associated with crowd shipping	Koopman, 2015
2	Variables such as weight, size and price of the package, and delivery urgency also seem to affect the willingness of crowd shippers to perform a delivery	Karakikes, 2018
3	The success of crowd shipping depends upon the incentives that will be given to crowd shippers or the length of the detour to perform a delivery	Simoni, 2019
4	Crowd shipping could be a boomerang to the system itself, depends on the mode used, crowd shipping could either increase or reduce the traffic congestions and CO2 emission produced by transport system	Wijanarko, 2022
5	It is necessary to know in advance whether to load customers' goods on in-house vehicles or assign them to ODs.	Mancini, 2022
6	The issue of the potential misuse of personal data.	Alharbi, 2022
7	Some female customers prefer not to interact with male drivers based on cultural and religious grounds.	Alharbi, 2022

Table 6 shows some of the challenges experienced during the implementation of crowd shipping. In fact, implementing crowd shipping is not as easy as imagined. Small things such as incentives for drivers, luggage size, shipping insurance, ease of loading and unloading goods, and privacy are the determining factors for the success of crowd

shipping implementation. In other case, crowd shipping can be a lucrative option for certain companies with the right considerations. Examples of this include retailers who do not offer same-day delivery services. In these cases, a static and deterministic model is appropriate. A dynamic representation would work, for instance, in the context of electrical/electronic material distribution (such as cables), for which a large stock is available in the warehouse. In this case, all the required materials can be loaded in-house vehicles. Once a suitable OD appears, a new cable can be given to them, and the traditional driver can skip the delivery (Manicini, 2022).

The other challenge stated by Archetti and Mancini about drivers' incentive or bundle. Archetti (2016) in his research do not address an actual bidding phase but consider a fixed compensation for each delivery performed, which is independent of the detour implied for the OD. This may be considered unfair as two different ODs may incur completely different extra mileages to serve the same customer but would receive the same compensation. Whereas Mancini (2022) in his research, Mancini let the ODs decide the bundles for which they want to bid and the value of the bid. In reality, bidding decisions are entirely up to drivers. The company just receives the bids from them without knowing how prices are computed.

The challenges of implementing crowd shipping in table 4 can be a lesson for implementing crowd shipping. In addition to smooth communication, operational matters will determine the interest of prospective crowd shipping actors to be involved in it. The existence of obstacles in the implementation of crowd shipping allows for failure. However, a statement of failure or success in implementing crowd shipping will be difficult to identify if there are no clear parameters.

5.6 Crowd shipping Success Measure

Crowd shipping is applied to achieve efficiency in logistics. Efficiency in the logistics sector can be achieved if the implementation of crowd shipping is successful. Therefore, it is important for us to determine what parameters can be used as a reference for crowd shipping success. Table 7 below can be used as a reference for measuring the success of crowd shipping parameters.

Table 7**.** Clodhopping's success indicator.

Parameter	Definisi	Penulis
Public Transport Punctuality	Percentage of public transport arriving at each station on time according to a predetermined/published schedule.	Li, 2015
Average travel time of public transport	The actual average travel time for a trip from one place to another divided by the free flow travel time.	Li, 2015
Reduction of mean arterial active velocity at peak period	The reduction in the average speed of vehicles traveling on arteries during the peak period (shown as a percentage dan dibandingkan dengan kecepatan rata-rata yang dikumpulkan).	Li, 2015
Variation Index	Standard deviation coefficient that shows the variation of travel time and reflects the reliability of travel time.	Li, 2015
Buffering Time Index	Extra time is needed to maximize the probability of reaching the goal on time.	Li, 2015
CO emissions	Average daily total CO emissions (tonnes)	Miranda, 2012; Silva, 2015; Braga, 2019
CO2 Emission	Average daily total CO2 emissions (tonnes)	Miranda, 2012; Silva, 2015; Braga, 2019
Traffic Noise	Average traffic noise level per day (db)	Silva, 2015; Braga, 2019
Fuel Consumption	Average total consumption of fuel oil per day (liters)	Silva, 2015; Braga, 2019
Travel Distance	Average distance traveled per day	Miranda, 2012; Silva, 2015

Travel time	Average travel time per day	Miranda, 2012; Silva, 2015; Braga, 2019
Number of Trips	Average number of trips per day	Miranda, 2012; Silva, 2015; Braga, 2019

The above parameters can be used to measure the success of crowd shipping implementation. Researchers can compare the situation before and after the implementation of crowd shipping based on these parameters. For example, the punctuality of public transportation and the average travel time, if crowd shipping is successful, public transportation should be able to arrive on time or even faster, and the average travel time will also decrease because traffic density is expected to decrease. If the number of motorized vehicles passing by is reduced, of course air pollution will also decrease. This parameter is very helpful for us in determining the success or failure of the research we are doing. To ensure that our results are valid, showing that there is a change between before and after the implementation of crowd shipping, the application of hypothesis testing can be carried out to support our statement.

6. Conclusion

This study underscores the problems related to the population explosion due to urbanization which is followed by an increase in the use of vehicles and logistics activities in urban areas. Increasing logistics activities without proper management will lead to inefficiencies that have serious impacts on the environment. Crowd shipping is one of the concepts that can be used in an effort to increase the efficiency of logistics activities. Crowd shipping is the concept of maximizing vehicle capacity resources from people who are traveling by entrusting goods to be sent to the same destination as the trip.

To facilitate understanding related to crowd shipping, a clustering was made using co-occurrence analysis. Co-occurrence analysis was conducted on 949 articles from 2013-2022 containing the keyword crowd shipping. The results of the co-occurrence analysis show that there are 4 research clusters that are formed when discussing crowd shipping. The first cluster is the actor in crowd shipping, the second cluster is the context or basis of crowd shipping, the third cluster is the need or component in the implementation of crowd shipping, and the fourth cluster is urban mobility.

The second cluster obtained from co-occurrence analysis is used to describe the concept of crowd shipping. Crowd shipping itself is a logistics efficiency effort to deliver goods to the final recipient or what is known as last mile delivery. Last mile delivery has become popular because of the increase in e-commerce activity. In this study, it was found that crowd shipping itself can involve various movement of people, such as cyclists, students who want to go to campus, kiosk visitors, and public transportation.

Nevertheless, as mentioned in the previous chapter, crowd shipping cannot run well without the role of technology in logistics activities. Logistics activities that are embedded with technology are known as the smart logistics concept. The integration between crowd shipping and smart logistics can increase the feasibility of implementing crowd shipping. As for the several steps of the crowd shipping process, such as, the process of sending information to drivers regarding the availability of goods that are ready to be sent along with the delivery destination, for this process alone there are many things that must be considered referring to cluster 3 which was formed in the previous chapter. Communication, Network System Triggers, Transport Journeys, Transport Provider Devices, Transport Systems, Transport User Devices, Online, Platforms, and Applications are needed to ensure complete information reaches the driver application. All of these requirements if done manually will be very complicated and time consuming. With the application of smart logistics such as Artificial intelligence, route selection, driver recommendations, information delivery for both drivers and senders, will be generated automatically and take a relatively short time. That's why crowd shipping needs to be integrated with smart logistics.

However, there are still many things that need to be considered in the implementation of crowd shipping. The results of the literature review found that there are several issues that often go unnoticed in the implementation of crowd shipping, such as: shipping insurance, item size, driver incentives, misuse of personal information, and cultural issues. Some even say that crowd shipping can become a boomerang depending on the mode used, crowd shipping itself can

allow for an increase in traffic density and CO2 emissions. Therefore, it is necessary to measure whether the implementation of crowd shipping is successful or not.

Based on the literature review that has been carried out, the results show that there are 10 parameters that can be used to ensure the successful implementation of crowd shipping. If crowd shipping is successful, the delay and average travel time of public transportation will decrease. in addition, CO emissions, CO2, traffic noise will decrease due to the reduced number of passing vehicles. The decrease in the number of passing vehicles should also have an impact on the decrease in fuel consumption and the average distance traveled by the total vehicle.

References

Alharbi, A., Cantarelli, C., Brint, A., Crowd models for last mile delivery in an engineering economy. *Sustainability,* 14, 1401, 2022.

Ali, I. and Golgeci, I., Where is supply chain resilience research heading? A systemaatic and co-occurrence analysis, *International Journal of Physical Distribution & Logistics Management*, vol. 49, no. 8, 793-815, 2019.

Allahviranloo, M., Baghestani, A., A Dynamic Crowdshipping Model and Daily Travel Behaviour. *Transportation Research Part E*, 128, 175-190, 2019.

Archetti, C., Savelsbergh, M., Speranza, M.G., The vehicle routing problem with occasional drivers. *European Journal Operation Research*, 254(2), 472–80, 2016.

Boysen, N., Emde, S., Schewedfeger, S., Crowdshipping by Employees of Distribution Centers: Optimization Approaches for Matching Supply and Demand. *European Journal of Operational Research*, 296, 539-556, 2022.

Braga, I. P. C., Dantas, H. F. B., Leal, M. R. D., Almeida, M. R., & Santos, E. M., Urban mobility performance indicators: a bibliometric analysis. *Gestão & Produção*, 26(3), e3828, 2019.

Chung, S.H., Applications of smart technologies in logistics and transport: A review. *Transportation Research,* 153, 2021.

Correira, D., Marques, J. L., Teixeira, L., City@PATH: A Collaborative smart city Planning and Assessment tool. *Journal of Transportation Development Integration,* 2022.

Davis, J., Mengersen, J., Bennet, S. and Mazerolle, L., Viewing systematic revies and meta-analysis in social research through different lenses. *SpringerPlus,* Vol. 3, 511, 2014.

Eck, N.J. (2011). Methodological advances in bibliometric mapping of science. PhD thesis, Erasmus University Rotterdam.

Galkin, A., Schlosser, T., Capayova, S., Takacs, J., & Kopytkov, D., Attitudes of Bratislava citizens to be a crowd-shipping non-professional courier. *Transportation Research Procedia*, 55, 152-158, 2020.

Gdowska, K., Viana, A., Pedroso, J.P., Stochastic Last-Mile Delivery with Crowdshipping. *Transportaion Research Prcedia*, 30, 90-100, 2018.

Ghaderi, H., Tsai, P., Zhang, L., Moayedikia, A., An Integrated Crowdshipping Framework for Green Last Mile Delivery. *Sustainable Cities and Society*, 78, 2022.

Giuffrida, N., Pira, M.L., Fazio, M., Inturri, G., Ignaccolo, M., On the Spatial Feasibility of Crowdshipping Services in University Community. *Transportation Research Procedia*, 52, 19-26, 2021.

H, Chourabi et al., Understanding smart cities: An integrative framework. Proc. Annu. Hawaii Int. Conf. Syst. Sci., no. July 2014, pp. 2289–2297, 2012.

Han, L., Zhou, W., Li, W., Li, L., Impact of urbanization level on urban air quality: A case of fine particles (PM2.5) in Chinese cities, *Environmental Pollution*, 194, pp. 163-170, 2014.

Hofmann., Anett., Guanghua, W., Determinants of Urbanization. *ADB Economics Working Paper Series*, No. 355, 2013.

Jabeur, N. et al., Toward Leveraging Smart Logistics Collaboration with a Multi-Agent System Based Solution. *Procedia Computer Science*, 109C, pp. 672–679, 2017.

Karacan, I., Erdogan, I., Cebeci, U., A comprehensive integration of RFM analysis, cluster analysis, and cassification for B2B customer relationship management. *Proceedings of the 4th European International Conference on Industrial Engineering and Operation Management, Rome, Italy,* 2021.

Karakikes, I., Nathanail, E., Adamos, G., Karatsoli, M., Social media users as carriers into the last mile delivery. In Proceedings of the hEART 2018: 7th Symposium of the European Association for Research in Transportation, Athens, Greece, 5–7 September 2018.

Kauf S., City logistics - a strategic element of sustainable urban development. *Transportation Research Procedia*, 16, pp. 158-164, 2016.

Kirch, M., Poenicke, O., Richter, K., RFID in Logistics and Production – Applications, Research and Visions for Smart Logistics Zones. *Procedia Engineering*, 178, pp. 526 – 533, 2017.

Koopman, C., Matthew, M., Adam, T., The Sharing Economy and Consumer Protection Regulation: The Case for Policy Change. *Journal of Business Entrepreneur Law*, 8, 529–545, 2015.

Korczack, J., Kijewska, K., Smart Logistics in the development of Smart Cities. *Transportation Research Procedia*, 39, pp. 201-211, 2018.

Li, R., Kido, A., Wang, S., Evaluation index development for intelligent transportation system in smart community based on big data. *Advanced in mechanical engineering,* 2014.

Liberati, A., Altman, D., Tetzlaff, J., Mulrow, C., Gotzche, P., Ioannidis, J. and Moher, D., The PRISMA Statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *Annals of Internal Medicine,* Vol. 151, no. 8, 2009.

Mancini, S., Gansterer, M., Bundle generation for last-mile delivery with occasional drivers. *Omega,* 108, 2022.

Mckinnon, A., Crowdshipping: a Communal Approach to Reducing Urban Traffic Levels? *Research Gate,* 2016.

Miranda, H. F., & Silva, A. N. R., Benchmarking sustainable urban mobility: the case of Curitiba, Brazil. *Transport Policy*, 21, 141-151, 2012.

Moher, D., Liberati, A., Tetzlaff, J. and Altman, D., Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Annals of Internal Medicine,* Vol. 151, 264-269, 2009.

Ni, M., He, Q., Liu, X., Hampapur, A., Same Day Delivery with Crowdshipping and Store Fulfillment in Daily Operation. *Transportation Research Prcedia*, 38, 894-913, 2019.

Nocerino, A., Colorni, F., Lia and A., Luè, E-bikes and E-scooters for Smart Logistics: Environmental and Economic Sustainability in Pro-E-bike Italian Pilots. Transp. Res. *Procedia*, 14, pp. 2362–2371, 2016.

OECD, OECD (2012), OECD Environmental Outlook to 2050, OECD Publishing. 2012.

Oliveira, A.H.S., Savelsbergh, M.W.P., Veelenturf, L.P., van Woensel, T. Chapter 15—Crowd-Based City Logistics. In Sustainable Transportation and Smart Logistics, Faulin, J., Grasman, S.E., Juan, A.A., Hirsch, P., Eds., Elsevier: Amsterdam, The Netherlands, 2019.

Paloheimo, H., Lettenmeier, M., Waris, H., Transport reduction by crowdsourced deliveries—A library case in Finland. *Journal Clean Production*, 132, 240–251, 2015.

Pourrahmi, E., Jaller, M., Crowdshipping in Last Mile Deliveries: Operational Challenges and Research Opportunity. *Socio-Economic Planning Sciences*, 78, 2021.

Punel, A., Ermagun, A., Stathopoulos, A., Push and Pull Factors in Adopting a Crowdsourced Delivery System. *Transp. Res. Rec,* 2673, 529–540, 2019.

Serafini, S., Nigro, M., Gatta, V., Marcucci, E., Sustainable Crowdshippung Using Public Transport: a Case Study Evaluation in Rome. *Transportation Research Procedia*, 30, 101-110, 2018.

Silva, A.N.R., Filho, M.A.N.A., Macedo, M.H., Sorratini, J.A., Silva, A.F., Lima, J.P., Pinheiro, A.M.G.S., A comparative evaluation of mobility conditions in selected cities of the five Brazilian regions. *Transport Policy,* 37, 157-156, 2015.

Simoni, M.D., Marcucci, E., Gatta, V., Claudel, C., Potential last-mile impacts of crowdshipping services: A simulation-based evaluation. *Transportation,* 47, 1933–1954, 2019.

Taniguchi E., Thompson R.G., Qureshi A.G., Modelling city logistics using recent innovative technologies. *City Logistics*, 46, pp. 3-12, 2020.

Tiejun, P., Value Chain Analysis Method of Smart Logistics Using Fuzzy Theory. *Information Technology Journal*, 11, pp. 441-445, 2012.

Trappey, A.J.C, Trappey, C.V., Fan, C., Hsu, A.P.T., Li, X., Lee, I.J.Y., IoT patent roadmap for smart logistic service provision in the context of industry 4.0. *Journal of the Chinese Institute of Engineers,* 40, 593-602, 2017.

United Nation, 2021. www.un.org. Diakses pada tanggal 1 November 2021.

Wicaksono, S., Lin, X., Tavasszy, L.A., Market potential of bicycle crowdshipping: A two-sided acceptance analysis. *Research in Transportation Business & Management,* 2021.

Wijanarko, F., Potential impact of car-based crowdshipping on vehicle mileage and carbon dioxide emision, 2022.

Yi, P., Li, W., Zhang, D., Sustainability assessment and key factors identification of first-tier cities in China. *Journal of Cleaner Production*, 2021.

Zehtabian, S., Larsen, C., & Wøhlk, S., Estimation of the arrival time of deliveries by occasional drivers in a crowd-shipping setting. *European Journal of Operational Research*, 2022.

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