Cross Docking Distribution System Design

Albertus Laurensius Setyabudhi, Humala L. Napitupulu, Rosnani Ginting and Meilita Tryana Sembiring
Program Studi Doktoral Ilmu Teknik Industri
Universitas Sumatera Utara
Medan, 20222, Indonesia
Corresponding Author: albertuslssby@gmail.com

Abstract

PT. XYZ is a logistics service company located in Batam. The problems that occur at this time are the problem of overcrowding in the warehouse and wrong sorting. This study aims to identify how the proposed efficiency improvement in the distribution system of goods using the cross docking method. The method that will be used in this research is the cross docking method. Cross docking is eliminating the storage process in the warehouse, so it can save time and money. The cross docking distribution system does not have continuous storage of goods, because its function is only a transit point for a shipment of goods. Goods are not stored for a long time, so the flow of goods is received until they are sent back, which is about 2-3 hours, or a maximum of 12 hours, in the warehouse, there are no available shelves or zero inventory. Based on the research, the data processing and discussion results are very profitable, namely efficiency for zero inventory. Shows that if the company adds 1 sorting table to 6 sorting tables with a result of 90,000kg, once loading and unloading aircraft is ±77,000kg, this can be shown to be 90,000kg>77,000kg efficiency is generated because the output of the sorting table is greater than the incoming input so that there are no goods stored in the warehouse and increase the number of trucks by 10 units, then the delivery of goods can be done one way and no goods are stored in the warehouse. The results of the analysis can be said that the application of cross docking in the company gains efficiency in the distribution of goods to expedition partners.

Keywords
Cross docking, Efficiency, Distribution, Warehouse, Storage

1. Introduction
In today's global era, various companies are competing to improve efficiency to gain profit, one of which is by paying attention to the problem of the logistics distribution system. According to Li, logistics is the management of the flow of goods from a point of origin ending at the point of consumption to meet certain demands, for example, directed to consumers or companies (Li, 2014). The types of goods in the logistics sector consist of physical tangible objects such as food, building materials, animals, equipment, and fluids. Similarly, the movement of intangible objects (abstract) such as time, information, particles, and energy. Physical goods logistics generally involve the integration of information flow, material handling, production, packaging, inventory, transportation, warehousing, and security. Complexity in logistics can be analyzed, described into a model, visualized, and optimized with existing simulation software.

One of the logistics service companies, precisely in Batam, is a freight forwarding company that manages loading and unloading, cargo container transportation services, air warehousing services, temporary storage places, and property rental services, both closed and open warehouses, as well as public refueling station services. PT. XYZ has a problem regarding distribution efficiency performance. Based on the identification of data from the customer, there are several problems faced, namely the problem of full load in the warehouse, rescheduling aircraft, and wrong sorting of goods.

2. Method
This research was conducted at a logistics company based on Batam City. The period from this research is January 2022 to June 2022. In this primary data, the data collected is the result of interviews. The technique of collecting data by interview is to get information by asking directly employees who work at PT XYZ. Secondary data is supporting data for the research conducted. The secondary data collected includes supporting data for designing a cross docking

distribution system, such as documents, records, official archives, and other literature relevant to the problem under study.

The population is the whole of an object or subject that has certain quantities and characteristics to be studied. The population provides research information (data) which can then be concluded (Sugiyono, 2014). The population of this study is all items that use the X plane. According to Siyoto, the sample is a part of the total population, or a small part of the population taken according to the procedure so that it can represent the population. The sample in this study is the goods that accumulate in the warehouse and the number of samples from this research is 97 (Siyoto & Sodik, 2015).

This research has two types of variables: the independent variable and the dependent variable. The independent variable is a variable that can influence/be the cause of changes in research (Andersson et al., 2020). The independent variable in this study is the type of truck transporting goods. The dependent variable is the variable that is influenced/caused, due to the presence of an independent variable (Andersson et al., 2020). The dependent variable in this study is the distribution of goods.

This research also has operational variables of truckload distribution which are divided into two categories, namely:

a. Full truck distribution load
   A full truckload is a full truckload. Full Truckload Shipping is used for large shipments that require entire truck space. With Full Truckload delivery, delivery of goods is carried out exclusively, where one item loaded in one truck comes from one shipper. The sender can order a truck with full capacity and also not fully loaded during delivery, this makes the sender not have to worry about the shipment being mixed with other goods (Kim et al., 2022).
b. Truck distribution load is not full
   An incomplete truckload is the delivery of various goods by several shippers in one truck, which serves as the fulfillment of truck capacity (Kim et al., 2022).

3. Analysis and Result

A. Warehouse Distribution System

The following are the stages of data processing in the distribution system of the logistics company under study, namely:

a. Warehousing System
   1. Receive a buffer request form
   2. Identify goods and packing
   3. Process receipts
   4. Arrange delivery
b. Truck Scheduling
   1. The receiving truck arrives at the receiving dock and unloads the product to the airport receiver.
   2. The product is scanned and verified at the receiving dock. In some cross docking systems, the product is also weighed, measured, and labeled at the receiving dock.
   3. Products are placed on a sorting system and sorted by destination.
   4. The product is transferred to the proper location in the shipping dock.
   5. The delivery truck loads the product from the shipping dock and leaves the shipping dock.

Here are the details of the distribution of goods for the XYZ aircraft, namely:

a. XYZ aircraft expedition, turnover at 10 expedition partners ±14,000 kg per week.
b. Loading and unloading route to Batam, from:
   - East : Surabaya
   - West : Jakarta
   - Sumatra : Medan, Deli Serdang dan Pekanbaru.
c. Capacity of aircraft is ±233.000 kg
d. The aircraft conducts 2 loadings and unloading of goods a day in Batam
e. PT. XYZ have 1 truck for 1 Mitra, they have 10 partners so they also have 10 truck.
f. 1 truck can load 13 pallets, containing from 1 pallet 15 sack, 1 sack weight is ±20kg
g. Aircraft unloading once an item weighing ±77,000kg

h. There are 5 sorting tables, 1 sorting table can be sorting ± 15.000 kg/day

2. Calculation of goods allocation

a. 5 sorting table x 15.000 kg = 75.000kg/once loading and unloading in a day. 75.000 x 2 = 150.000kg if overtime, there are still 2,000 kg left unsorted/day x 7 days = 14.000kg stock in warehouse.

b. Delivery per truck 75.000kg : 3.900kg = 19 trucks, while the trucks owned by 10 trucks. If delivery is carried out, the truck will deliver 2 times to the expedition partner.

The distribution of the X aircraft expedition has so far implemented a buffer with a period of one week or as much as 14,000 kg in its main warehouse (Figure 1).

Figure 1. Main warehouse floor plan as a distribution center

Distribution System

Things that are considered less efficient and effective are goods entering the main warehouse, storage is not only for one main partner but also for goods from other partners with unclear allocations for both the amount and type of goods. Goods are allocated based on a certain percentage regardless of the type of goods, although it is known that each partner has different types of goods with different categories. In the main warehouse, there are goods with long-term storage due to the irregular location of the storage of goods. The flow of goods and information can be seen as follows in Figure 2:

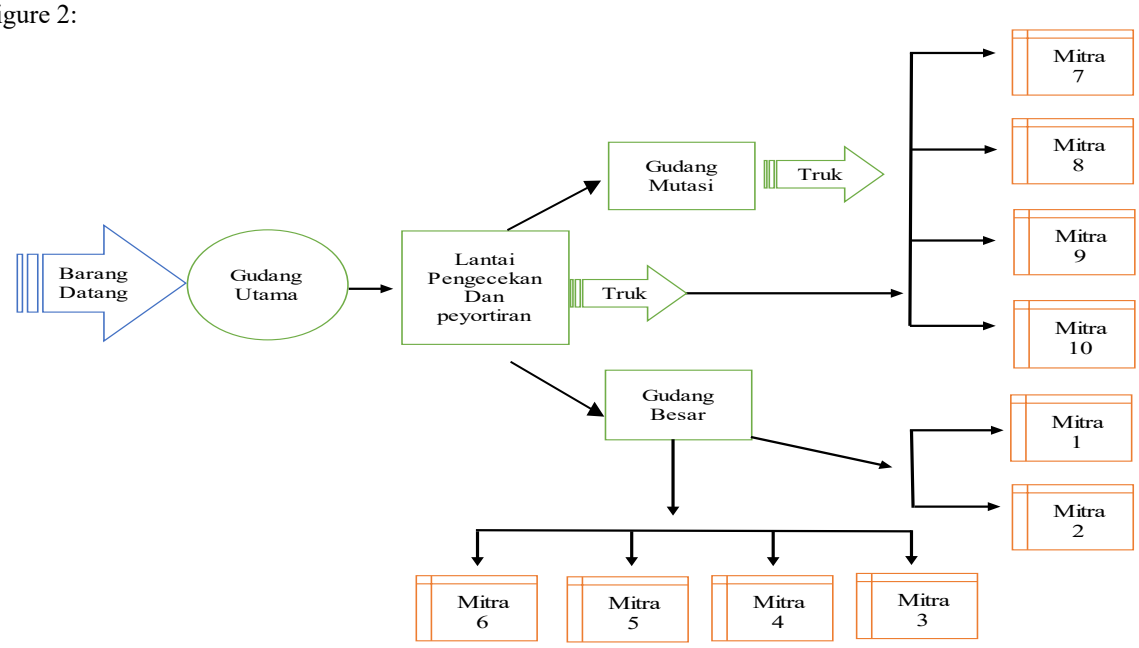

Figure 2. Goods Flow

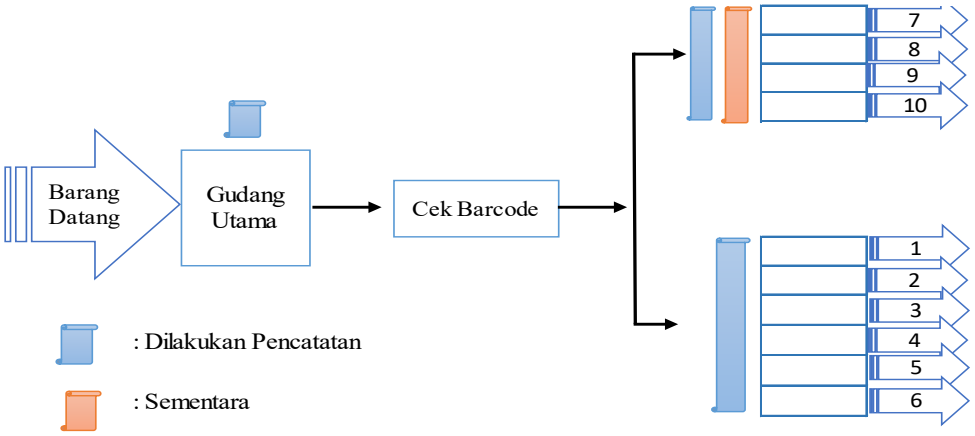

Figure 3. Old Job Process

The Figure 3 explains that the process of goods coming to the main warehouse, to the checking and sorting floor after that the goods are distributed directly and the goods are separated into two warehouse categories, namely large warehouses and mutation warehouses after that, then distributed to each expedition partner.

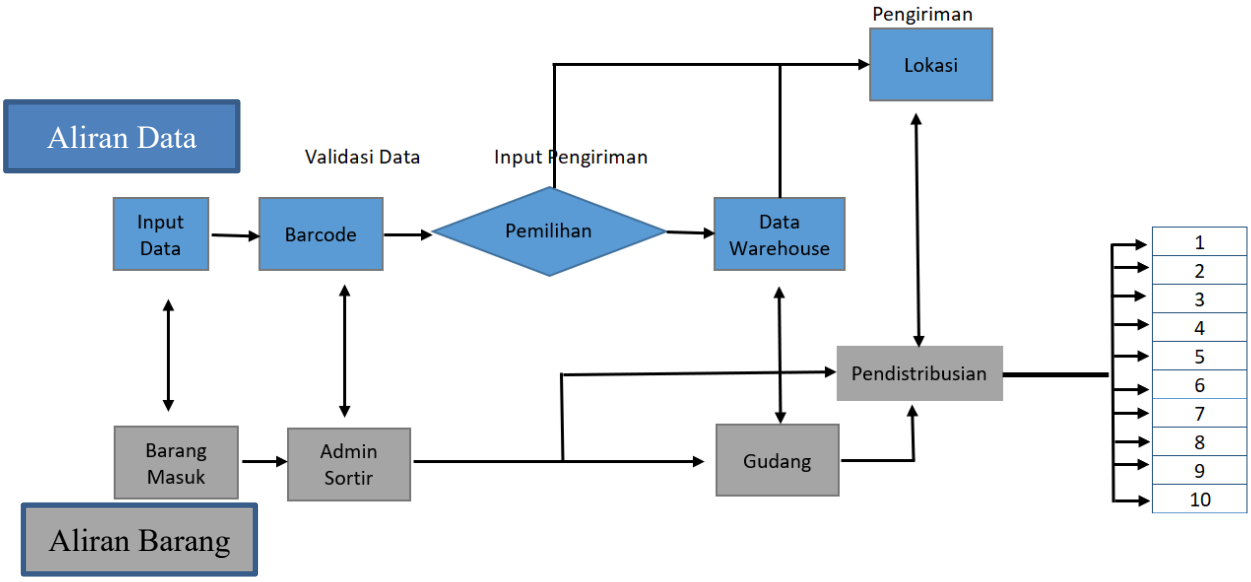

Figure 4. Goods Flow and Information Flow before Cross Docking Design

Figure 4 above explains that the work carried out is divided into two streams, first is the flow of goods and the second is the flow of information. The flow of goods in the work is as follows:

1. Incoming, where the goods are unloaded from the aircraft and taken to the sorting place.
2. Admin Sort, goods are received admin sort and checked and validated.
3. Warehouse, goods after sorting there are stored in the storage warehouse.
4. Distribution, goods after sorting there are directly sent to partners.

The flow of information in this work is as follows:

1. Input Data
2. Barcode for validation data
3. Choice, in this stage we choose input data to warehouse or outgoing to customer
4. Warehouse

5. Distribution

B. Distribution Crossdocking System Design

Crossdocking Distribution System

The cross docking system aims to ensure that goods can be delivered directly to partners without storing them in the DC warehouse. Added 1 table for sorting and added 10 trucks, so each partner has 2 expedition trucks to deliver goods packages.

a. Sorting table 15,000 kg x 6 = 90,000 kg/one loading and unloading in a day. 75,000 x 2 = 150,000 kg for overtime work, then 90,000 kg x 2 = 180,000 kg of goods can be sorted without doing warehouse storage because 180,000 kg > 150,000 kg.
b. Delivery per truck 75,000kg : 3,900kg = 19 trucks, 10 existing trucks plus 10 trucks to help deliver goods, so no goods are stored.

Figure 5. Distribution center plan

The difference (Figure 5) between the crossdocking distribution system with the previous system is that there is no storage area for goods shelves and a number of work desks are added. The flow of goods distribution administration system in DC can be seen in detail, as follows in Figure 6:

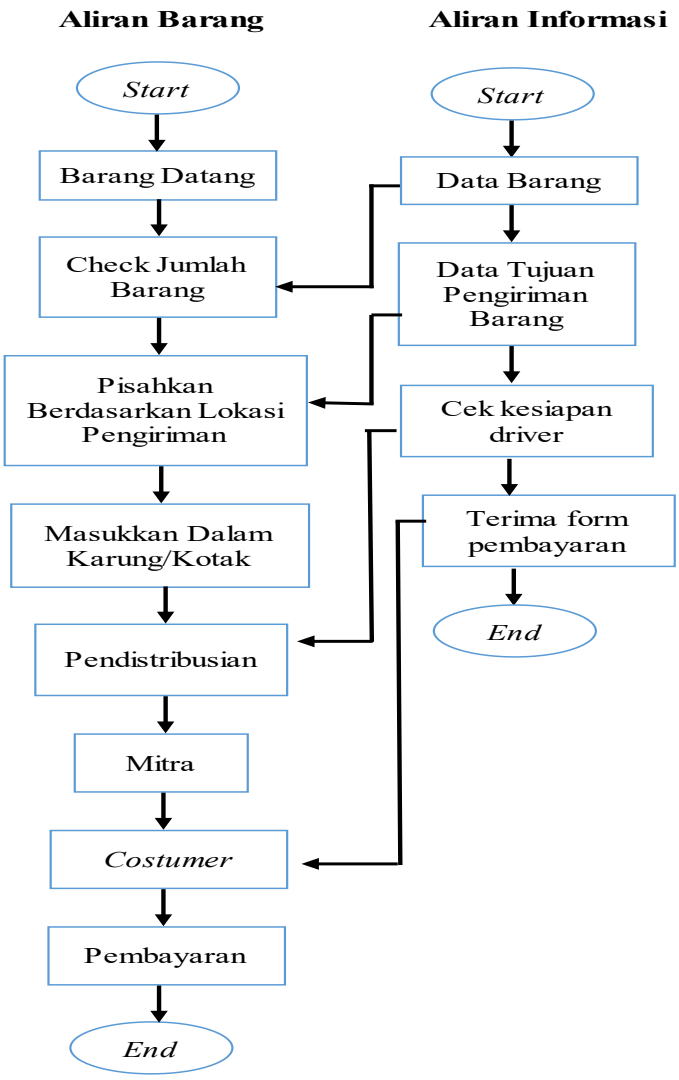

Figure 6. Flowchart Crossdocking Distribution System

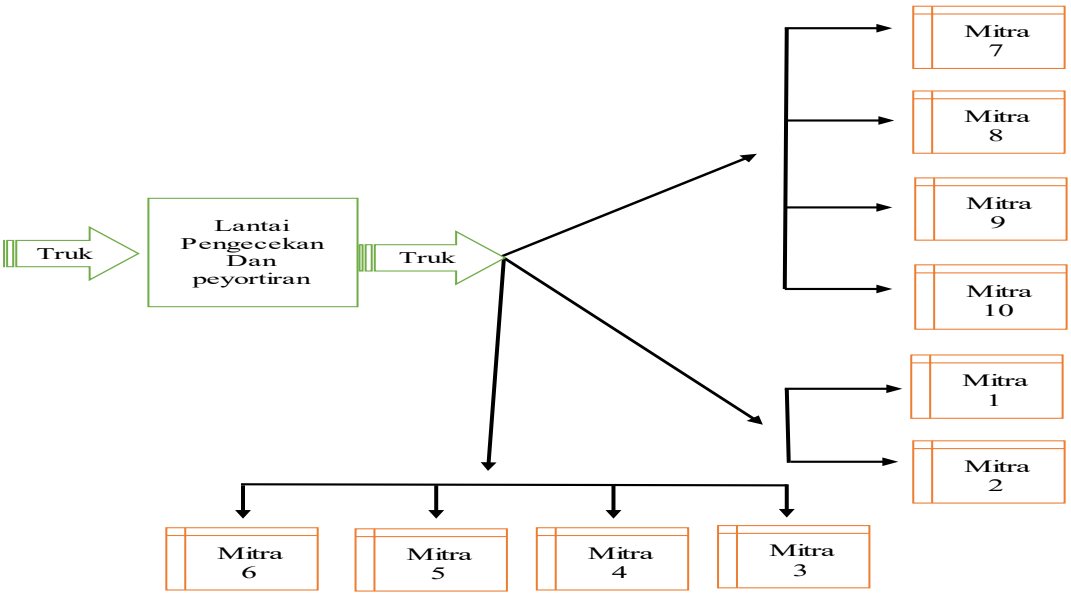

Figure 7. Goods Flow

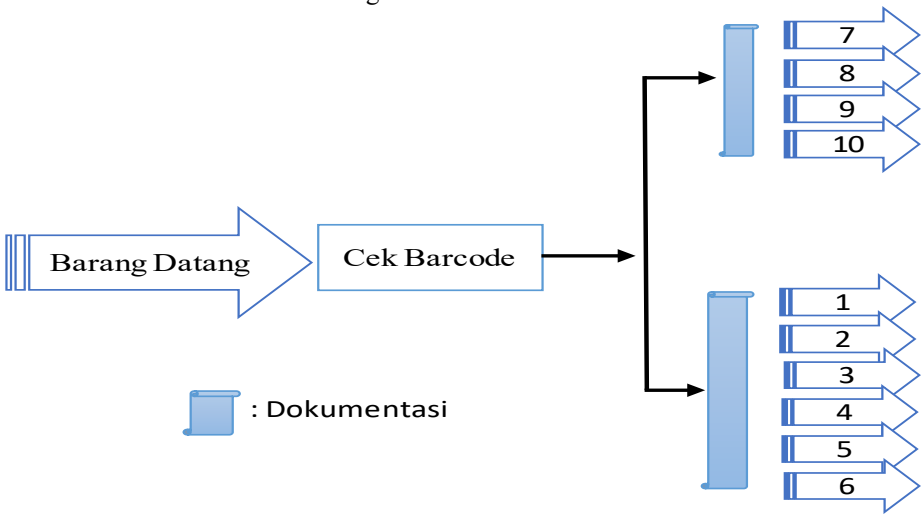

Figure 8. Flow of Goods and Recording to Partner Shipments

The Figure 7 and figure 8 explains that the flow of goods distribution using the crossdocking method is by eliminating the storage/warehouse area. The difference between the old distribution flow and the new design is that there is no place to store goods, in the new distribution design process the goods arrive at the sorting point directly distributed to expedition partners so that no goods are stored.

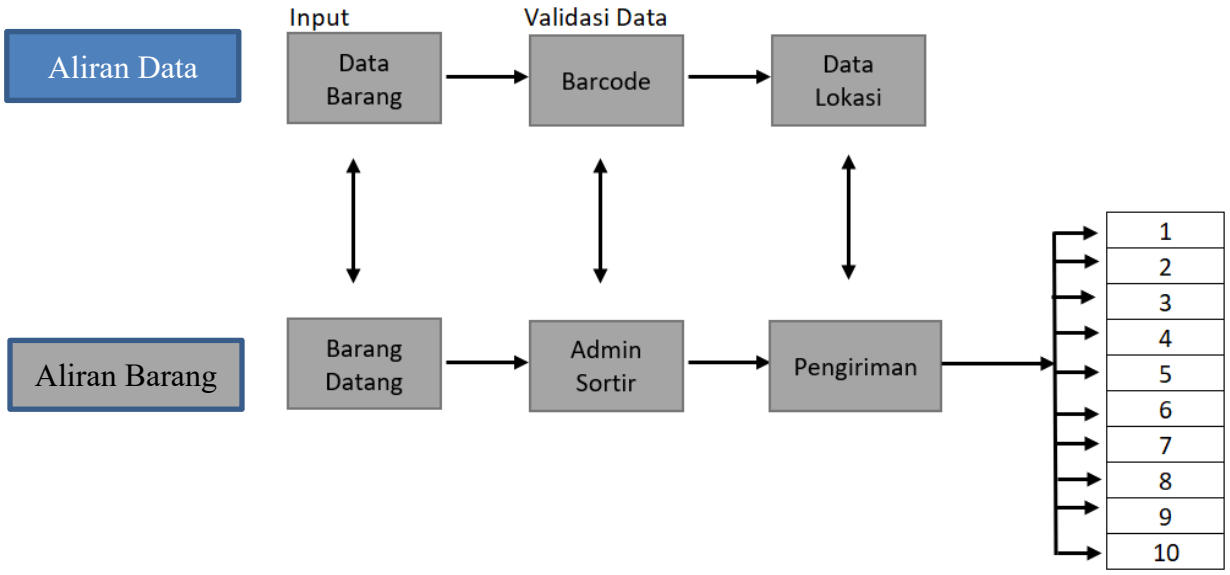

Figure 9. Goods Flow and Information Flow after Cross Docking Design

In the explanation of the Figure 9 above, it shows the goods that have arrived, the barcode process is carried out then inputting data containing data on shipping goods and identification of goods is then sent to each expedition partner.

C. Calculation

In this study, the number of existing populations is uncertain depending on the consumer who makes the delivery of goods, for that the number of samples used is 97 samples (Riduwan & Akdon, 2013). From the 97 samples, the results of data processing are shown below in Table 1.

Table 1. Uji Normalitas Data

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Meja_Sortir	.313	97	.000	.748	97	.000
Jumlah_Packing	.343	97	.000	.636	97	.000
Waktu_distribusi_penyimpanan	.343	97	.000	.636	97	.000

a. Lilliefors Significance Correction

In Table 1 above is the normality test of research data after applying cross-docking to the existing distribution system. From the data normality test obtained it is known that the data is not normally distributed. Where seen from the sig value on the Kolmogorov-Smirnov test is less than 0.05. This is because indeed in this distribution it must be conditioned that the goods sent do not exceed the capacity of the aircraft and there cannot be too many of them. So it cannot follow the existing normal distribution.

Table 2. Uji Reabilitas

Case Processing Summary			
		N	%
Cases	Valid	97	100.0
	Excluded[a]	0	.0
	Total	97	100.0

N =97 r =0,199

Reliability Statistics	
Cronbach's Alpha	N of Items
.658	3

Table 2 shows Cronbach's Alpha of these three things is greater also than 0.6. For the reliability test, it can be seen from the Cronbach's alpha, if the Cronbach alpha is more than 0.6 then it is said to be reliable. Cronbach's Alpha obtained was 0.658 which means it is greater than 0.6.

Table 3. Uji Validitas

Correlations				
		Meja_sortir	Jumlah_packing	Waktu_distribusi_penyimpanan
Meja_sortir	Pearson Correlation	1	-.281**	.905**
	Sig. (2-tailed)		.005	.000
	N	97	97	97
Jumlah_packing	Pearson Correlation	-.281**	1	.010
	Sig. (2-tailed)	.005		.921
	N	97	97	97
Waktu_distribusi_penyimpanan	Pearson Correlation	.905**	.010	1
	Sig. (2-tailed)	.000	.921	
	N	97	97	97

On the sorting table the data retrieved is the number of sort admins used at the time of data retrieval. This will certainly affect the sorting time of the goods that arrive, this will indirectly certainly affect the existing distribution time. The number of packings is data on the number of goods coming or entering from planes coming to the Batam area. At the time of distribution, the storage loading data the length of the distribution takes place after implementing the cross docking design that has been designed..

The table above (Table 3) has been declared valid because it is in accordance with the provisions of the validity and reliability test. The basis for taking the validity test consists of two provisions, namely:

1. Pearson validity test (If the value of r count is more than r table = valid)
2. The significance value is 5% (If the significance value is less than 0.05 = valid)

The following is a design of the number of goods using the cross docking method.

$$\frac{\text{selisih rata−rata waktu distribusi}}{rata−rata\ waktu\ distribusi\ lama} x100\% = \frac{26}{56} x100\% = 46{,}4\% \text{ (Efisiensi waktu)}$$

The difference in the details of the data from the previous one is that data that has been designed using a cross docking system is more efficient due to the loss of 46,4% time in storing goods that will be stored on shelves to make the system work faster in sending goods to customers directly.

4. Conclusion

Based on the results of the design of the distribution center warehouse in the research that has been carried out using the cross docking method, the conclusions are:

1. Before designing the distribution center cross docking system, the thing that needs to be done is to identify the old warehouse first and then make a detailed schematic sequentially regarding the tasks and arrangement of the workflow of the distribution of goods.
2. In designing new dc requirements, there are several stages to clarify the process, namely identification of dc needs to be based on interviews with related parties.
3. The design of the cross docking system that has been made can eliminate 12% of the time so that it can save time in carrying out goods distribution work operations.

References

Andersson, U., Cuervo-Cazurra, A., & Nielsen, B. B, Explaining interaction effects within and across levels of analysis. In *Research methods in international business*, pp. 331–349, 2020.

Amirul huda, F. , Pengertian dan Langkah-Langkah Penelitian Meta Analisis. https://fatkhan.web.id/pengertian-dan-langkah-langkah-penelitian-meta-analysis/, 2020.

Arnaout, Georges, Elkin Rodriguez-Velasquez, Ghaith Rabadi, and Rami Musa. "Modeling Cross-Docking Operations Using Discrete Event Simulation." In Proceedings of the 6th International Workshop on Enterprise & Organizational Modeling and Simulation, 113–20. 2010.

Bastuti, Sofian, Rini Alfatiyah, Muhammad Shobur, and Adi Candra. 2019. "Manajemen Logistik."

Ballou Ronald, H. 1992. "Business Logistics Management." Englewood Cliffs: Prentice Hall.

Bowersox, Donald J, and Patricia J Daugherty.. "Logistics Paradigms: The Impact of Information Technology." Journal of Business Logistics 16(1): 65. 1995

Bowersox, Donald J, Theodore P Stank, and Patricia J Daugherty. "Lean Launch: Managing Product Introduction Risk through Response-based Logistics." Journal of Product Innovation Management: AN International Publication of The Product Development & Management Association 16(6): 557–68. 1999.

Budiman, E. V. Evaluasi Kinerja Supply Chain pada UD. Maju Jaya di Desa Tiwoho Kabupaten Minahasa Utara. Jurnal EMBA: Jurnal Riset Ekonomi, Manajemen, Bisnis Dan Akuntansi, 1(4). 2013.

Camalia, M. 2021. Potensi Kerugian akibat Manajemen Logistik yang Buruk. https://blog.mile.app/dampak-manajemen-logistik-yang-buruk-pada-bisnis/#:~:text=Manajemen logistik yang buruk dapat,bisa mengganggu perencanaan jangka panjang. 2021.

CSCMP, C. of S. C. M. P. Supply Chain Management Terms and Glossary. Retrieved from https://cscmp.org/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms.aspx, 2013.

Chapman, Ross L, Claudine Soosay, and Jay Kandampully. "Innovation in Logistic Services and the New Business Model: A Conceptual Framework." Managing Service Quality: An International Journal. 2002.

Goddefroy, Nathan, and M Alexandrer. "Optimizing the Dock Door Assignment Problem in Cross-Docking Warehouses." Universiteit Gent Faculteit Economie En Bedrijfskunde. 2013.

Gitosudarmo, Indriyo. "Manajemen Pemasaran." Yogyakarta: BPFE. 2000.

Indonesia, Shipper. "Pengertian, Jenis, Keuntungan Dan Kekurangan Cross Docking." https://blog.shipper.id/tips/pengertian-cross-docking/. 2021.

Kargo. "Apa Itu Cross Docking? Manfaat, Keuntungan, Dan Kekurangannya." 2021.

Kim, T.-O., Park, K.-J., Cho, Y.-N., Jin, H.-M., Jo, Y.-G., Kim, H. S., Ju, J. K., Shin, H.-J., Kho, B.-G., & Kee, S.-J. , Altered distribution, activation and increased IL-17 production of mucosal-associated invariant T cells in patients with acute respiratory distress syndrome. *Thorax*., 2013.

Li, X. , Operations management of logistics and supply chain: Issues and directions. *Discrete Dynamics in Nature and Society*, *2014*.

Mulyawan, Teddy. "Implementasi Sistem Crossdocking Untuk Meminimalkan Biaya Operasional Kendaraan (Studi Kasus Pada Distributor Unilever Cv Berkat Abadi Dan Cv Sinar Berkat Abadi)." 2017.

Michigan State University. (2020). Is Logistics the Same as Supply Chain Management? Retrieved December 7, 2021, from Michigan State University website: https://www.michiganstateuniversityonline.com/resources/supply-chain/is-logistics-the-same-as-supply-chain-management/

Parwati, Niken. "Penerapan Sistem Pergudangan Cross Docking Pada Industri Retail Yang Sedang Berkembang." INASEA 8(1): 1–15. 2007.

Qothrunnada, K. Pengertian Variabel dan Jenisnya dalam Penelitian. https://www.detik.com/edu/detikpedia/d-5821887/pengertian-variabel-dan-jenisnya-dalam-penelitian. 2021.

Riadi, Muchlisin. "Tujuan, Fungsi Dan Komponen Manajemen Logistik." https://www.kajianpustaka.com/2019/03/tujuan-fungsi-dan-komponen-manajemen-logistik.html. 2019.

Riduwan, A., & Akdon, A, Rumus dan data dalam analisis statistika. *Bandung: Alfabeta*., 2013.

Salim, Zamroni. "Kesiapan Indonesia Menuju Pasar Tunggal Dan Basis Produksi ASEAN: Sektor Jasa Logistik.". 2015.

Satria, B. , Apa yang dimaksud dengan meta-analisis? https://www.dictio.id/t/apa-yang-dimaksud-dengan-meta-analisis/120618, 2019.

Satria Wahono, R, SYSTEMATIC LITERATURE REVIEW: PENGANTAR, TAHAPAN DAN STUDI KASUS. 2016. https://romisatriawahono.net/2016/05/15/systematic-literature-review-pengantar-tahapan-dan-studi-kasus.

Siyoto, S., & Sodik, M. A, *Dasar metodologi penelitian*. literasi media publishing, 2015.

Sugiyono, *Metode Penelitian Kuantitatif Kualitatif dan R&D* (21st ed.). Alfabeta, 2014.

Tien, N. H., Anh, D. B. H., & Thuc, T. D. Global supply chain and logistics management. Dehli: Academic Publications. 2019.

TransGO. Minimalisir Penyimpanan, Alasan Indomaret dan Alfamart Pakai Sistem Cross Docking. http://www.transgo.co.id/minimalisir-penyimpanan-alasan-indomaret-dan-alfamart-pakai-sistem-cross-docking. 2021.

Yu, Wooyeon. Operational Strategies for Cross Docking Systems. Iowa State University. 2002.