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Location Choice of Distribution Center for Freshfood E-Commerce by the Approaching of Spatial Center of Gravity Method and Implementation of Halal Logistics Standard MS2400 (Case Study of Fresh Food Delivery to JABODETABEK)

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Abstract

The purpose of this research is trying to solve problems by various logistics parties in delivering fresh food (freshfood e-commerce) such as the high of shipping costs and the difficulty of maintaining the quality of fresh products because the value of these products will decrease exponentially after harvest. Implementation for strategy of grouping goods at distribution center in an optimal location as a transit center will result the reduction costs in the shipping process. The Center of Gravity (CoG) method is applied to measure the optimal point of the distribution location but this model does not consider regional spatial effects such as the effects of congestion, natural disasters, topography, economy, and security, therefore a spatial approach was added in the application of the Center of Gravity method (CoG) to reduce the spatial effects. The application of MS2400 as one of the best halal logistics standards is also applied to make standard procedures and layout designs to prevent decreasing in the quality of the products. The results of implementation the CoG method by using spatial approach found several recommendations for latitude and longitude points for distribution locations based on 5 delivery zones, such as Zone DC 1 Tangerang (-6.28010, 106.6684), Zone DC 2 Jakarta (6.16544, 106.7465), Zone DC 3 Jakarta (-6.276778, 106.8042), Zone DC 4 Bogor (-6.503629, 106.8340), and Zone DC 5 Bekasi (-6.27263, 107.19930). However, it was found that the usage of the CoG method with a spatial approach was not so significant in reducing spatial problems when it was compared to the classical CoG model. The implementation of the MS2400 standard requires several additional facilities such as temperature determination, a special medical checkup room, a prayer room, a cleaning facility room, a hygienic toilet room, a vehicle break room, and a room for separating damaged products.

Keywords; Freshfood E-Commerce, Distribution, Center of Gravity, Spatial, Halal Logistics

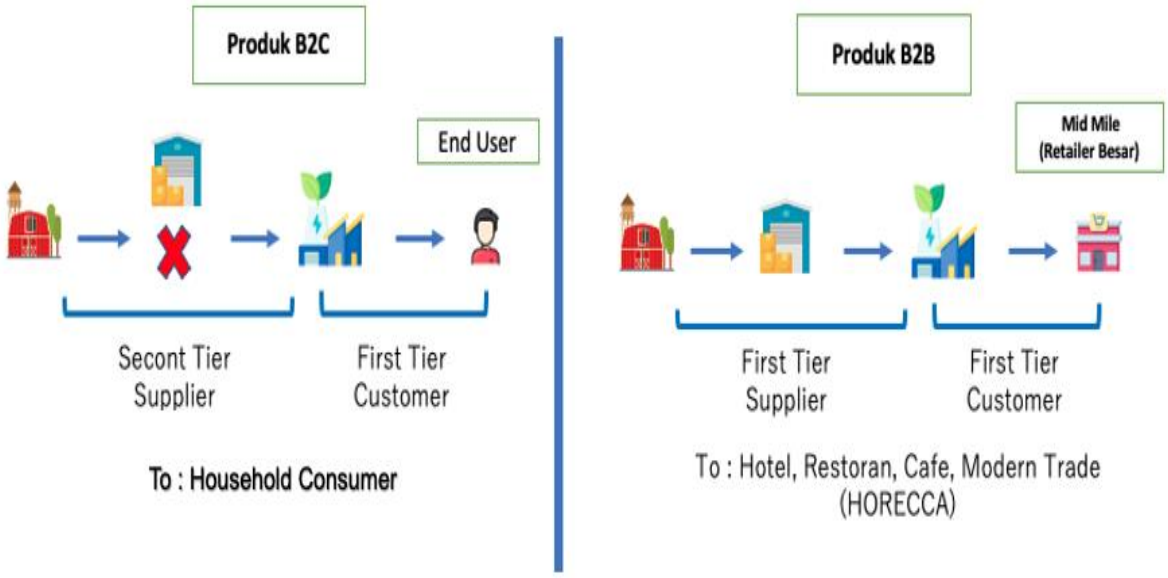
Introduction

The usage of information, communication and technology (ICT) in Indonesia shows that the most rapid development of ICT indicators is seen in household internet usage that reached 78.18 percent increased (Central Agency of Statistics/BPS Indonesia, 2021). The development of ICT has spread into electronic commercial which triggers a new momentum for the world economy. During 2017 to 2022 the phenomenon of online sales has increased 18 times due to the ease of internet access through buying and selling platforms (Google Analytics, 2022). This phenomenon creates a new chapter in online buying and selling trade which is called e-commerce.

The high demand and interest of e-commerce has impacted to the expansion of several e-commerce startups that focused on commercing of fresh food in Indonesia, such as Tani Hub Indonesia, Eden Farm, Kedai Sayur Indonesia, Segar), Sayur Box, Pasar Now. The growth of fresh food e-commerce prospects requires for a halal logistics system for fresh food shipments. As part of supply chain management which plays an important role in the process of storing, transporting and distributing products to consumers (Saribanon et al., 2019) in accordance with Law No. 33 of 2014 that concerning Guarantee of Halal Products in Indonesia which states that every product traded and circulated in Indonesia must be halal certified.

The speed of product distribution to consumers depends on the proximity between the distribution warehouses and the market (consumers). therefore some of the policies of e-commerce fresh food company are to cut the supply chain which initially reached 2 tiers, now it only goes through 1 tier for deliveries from suppliers while deliveries to the next tier it can be sent directly without intermediaries, so it is expected to cut the supply chain and cut costs significantly.

Picture 1: Fresh food E-Commerce Supply Chain



Source: Author's Observations (2022)

Blackburn & Scudder (2009);Zhao et al (2021) argues that the value of fresh produce deteriorates exponentially after harvest because it is easily damaged, as well as operational implementation Following are some of the obstacles as a result of the supply chain cutting policy such as:

1. High delivery time (High Travel Time)
   The average delivery time ranges from 7-9 hours (Vendor Operation Process, 2022), thereby reducing the quality of fresh food products and affecting the cost of product replacement.

2. Long travel distance (High Travel Distance)
   The travel distance of delivery process based on as result of shortening the supply chain is range of 90-100 km (Vendor Operation process, 2022) so it makes the cost of maintaining product quality will be very expensive.

The following is the Delivery Problem data that occurs when delivering e-commerce fresh food products in the final quarter of 2021.

Table 1: Report Delivery Problem October-December 2021.

Reason	Total	Tase	Persenta
Low Respond Customer		2	0,510%
Late Update		5	1,276%
Routing Problem		7	1,786%
Return Barang Dex	1	1	2,806%
Rain	3	2	5,867%
Traffic Jam	1	5	13,010%
Late	93	2	74,745%
Total	92	3 %	100,000

Source: Transport Operation Vendor Delivery (2021)

The highest percentage of problems occurred as a result of delivery delays (late) then followed by problems resulting from congestion, these delays dominated the result of long travel distances and long operational processing times both during delivery and during the product transit process, causing customer dissatisfaction, the decreased of product quality due to long delivery times and then affected to the costs that will increase due to complaints from customers.

Therefore the alternatives that will be carried out in this research is to build several Warehouses/hubs at strategic points according to the spatial location and standards to maintain the quality of goods when shipping and to shorten the distance and delivery time of these products as well as with a spatial approach to congestion analysis traffic, reducing

congestion in the city and reducing the estimated of harmful gases that is produced by vehicles in the transportation (Jardas et al., 2020).

The distribution of fresh food, especially raw meat commodities, must pay attention to the quality and halalness of the product in order to gain public satisfaction and guarantee the halalness of the product, but according to (Ashari, 2021) the delivery of these food and beverage products to consumers requires a good management system and quality. The management system that regulates the distribution and storage of this product is called the halal logistics system. The halal logistics system is part of the supply chain management in the halal food industry.

Based on the background of the problems and comparison of the results of previous studies, this research will try to solve the problem of high travel time and high travel distance which results in high costs and low quality of fresh food products in the fresh food e-commerce supply chain by building several hubs based on demand from previous shipments using the Center of Gravity (COG) method and a spatial approach as a solution to minimize error values in the results of using the Center of Gravity (COG) method, then standardizing the implementation of halal logistics in the form of standard operational procedures (SOP) with Malaysia's halal logistics standard (MS2400) as a standard to maintain the quality of these products and maintain halal integration by Law No. 33 of 2014 concerning guarantees of halal products in Indonesia.

This research focuses on e-commerce fresh food delivery to DKI Jakarta Bogor City, Bogor Regency, Bekasi City, Bekasi Regency, Tangerang City, South Tangerang City, Tangerang Regency, Depok City, and Karawang Regency.

In addition, delivery process at fresh food e-commerce uses 1 tier concept, which is delivered from the distribution center as the main warehouse/hub and then transited to the destination region as a spoke, the location of transit is the existing hub owned by the delivery vendor without calculations from existing shipping demand.

Halal logistics is adopted into a standard set of management system requirements consisting of:

1. Part 1: Transportation - General requirements
   This Malaysian standard sets out management system requirements for the assurance of the halal integrity of products, goods, and/or cargo handled through various modes of transportation.
2. Part 2: Warehousing - General requirements
   This Malaysian Standard specifies management system requirements for assurance of the halal integrity of products, goods, and/or cargo in warehouses.
3. Part 3: Retailing - General requirements
   This Malaysian standard sets out management system requirements for assurance of the halal integrity of products, goods, and/or cargo at the retail stage.

This study only focused on the use of standard Transportation General requirements and Warehousing General requirements because the object of research is related to distribution and warehousing.

Center of gravity (COG) method is used to optimize delivery at randomly dispersed locations (Assahara & Yamamoto, 2007);(Yusianto et al., 2021) by considering the equality of distances and demand volume in logistics distribution, the basic formula for CoG is the following equation (Sosa-Terrazas et al., 2018)

$$\overline{X} = \frac{\sum_i V_i R_i X_i}{\sum_i V_i R_i}, \overline{Y} = \frac{\sum_i V_i R_i Y_i}{\sum_i V_i R_i}$$

Where :

Vi = Volume flowing from (to) point I
Ri = Transportation rate to ship Vi from (to) point i
Xi,Yi = Coordinate points for point i
$\overline{X}, \overline{Y}$ = Coordinate points for facility to be located

Material and Methods

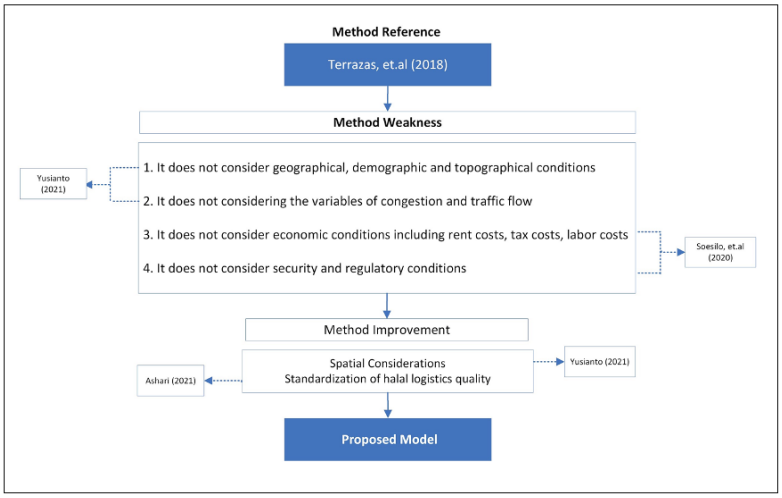
This research focuses on the delivery of fresh food e-commerce which analyzes the delivery of fresh food materials by taking case studies in delivery areas around Jakarta, Bogor, Depok, Tangerang, and Bekasi (Jabodetabek). The approach in this study uses quantitative analysis. Consumer mapping is using longitude and latitude point. However, the use of the center of gravity method has several weaknesses, such as not considering the following conditions (Yusianto et al., 2021):

1) Geographical, demographic and environmental topographical conditions of alternative areas;
2) Alternative regional economic conditions such as building rental cost, taxes, and labor costs;
3) Security conditions and alternative regional regulations;
4) The condition of infrastructure and congestion levels in alternative areas;

The Center of Gravity method is a location cost technique that will be used as a quantitative and mathematical technique to find external warehouse locations that will minimize shipping costs (Rahman Soesilo et al., 2020). Several uncertain factors also affects to the decision of determining the location such as geographical, environmental, and economic factors (Zhao et al., 2021) spatial analysis will optimize the real conditions in location choice of the center of gravity Barcheria, et.al, (2017);Yusianto et al (2021). Therefore, the spatial approach allows for variables that analyze traffic jams in a short time, reduce congestion in cities and reduce the estimated of harmful gases produced by vehicles in the transportation network (Jardas et al., 2020). Currently, several stakeholders are reducing food quality risks and vulnerabilities when the delivery process goes through various quality standards and

regulations such as ISO 9001 and Halal Standard Food. The use of halal logistics approach uses Malaysian Standard (MS) 2400 Malaysian Standard (MS2400) Part 2: Warehousing - General requirements, where companies must complete documents, warehouse conditions and apply good management, this standard was chosen because it is the best standard for managing halal materials and very specific, taking into account the need for the integrity of the fresh product.

Picture 2: Development Analysis



Source: Research, Author Analysis (2022)

The required data collection for this research as follows:

Table 2 : Collection of data based on categories and types of data

Data Category	Data Type
Primary Data	Coordinate point of delivery *latititude (X) and longitude (Y)*
	Delivery volume Capacity from/to point i
	Shipping rates Delivery price from/to point i
Secondary Data	Geoportal Data of Delivery Destinations Flood intensity level, Landslide intensity level
	Level of congestion Congestion during peak hours at each delivery point
	Economic value Land zone price, labor cost
	Security Crime rate
	Halal Logistics Standardization *Malaysian Standard 2400 Warehouse & Transport*
Tertiary Data	Geographic Condition The condition of the location of each recommendation point, the position of each recommendation point, the geographical form of each recommendation

Source: Author Analysis (2022)

The recommendation area were obtained from the National Spatial Information System (Sitarunas), where Sitarunas is a site from the Ministry of Agrarian Affairs/BPN which compiles spatial regulations both nationally and regionally. Meanwhile, sources from

Sitarunas are PP No. 13 of 2017 concerning National Spatial Plans, PP No. 28 of 2012 concerning the Java-Bali Spatial Plan, and PP no. 60 of 2020 concerning Spatial Plans for the Jabodetabekpunjur Urban Area.

Due to the distribution of customer points, latitude (X) and longitude (Y) data collection is divided into several zones :

Table 3: Coverage of Zones and Areas in Research

Zone	Area	Coverage Area
1	Tangerang Area	Covers the area of Tangerang City, Tangerang Regency, and South Tangerang City
2	Jakarta Area	Covers parts of North Jakarta to the east, West Jakarta, and Central Jakarta.
3	Jakarta Area	Covers parts of North Jakarta, East Jakarta and South Jakarta.
4	Bogor Area	Covering Bogor Regency, Bogor City, and Depok City
5	Bekasi Area	Covers the area of Bekasi Regency, Bekasi City and Karawang Regency.

Source: Author Analysis (2022)

Picture 3: Zone and Area Coverage for The Research

Source: Research, Author Analysis (2022)

There are several steps for using the center of gravity method that have been previously developed in this study. The steps for using the method are as follows:

1. Arrange the Spatial Variables to determine the most optimal distribution center location by considering several variables, such as temporal congestion, risky hazard zones, topography, demographics, and geography.
2. Calculating the Variable Ratio by determining the class and criteria for each spatial perspective to determine the value of each class then calculating the weight ratio with a total percentage of 100% of all spatial variables.
3. Determine the Variable Score (SV) for each spatial variable according to the following formula:

$$SV = \{SV1, SV2, ..., SVj\}$$

Scoring was determined by modifying the classification based on the Jenks Natural Break approach for consistency in this study using a score range of 1-10.

4. Calculating the Spatial Perspective Weight (SPW) based on the Ratio (R) and Spatial Variable (SV) that has been determined previously, the calculation of the spatial perspective weight (SPW) uses a formula by the following equation (Yusianto et al., 2021):

$$SPW_i = \Sigma\, R_{iv} \text{ x } SV_{ij}$$

Where :
SPW = Spatial perspective weights;
SV = Spatial variables;
R = The ratio of each spatial variable;
i = Alternate number;
j = Number of spatial variables.

5. Convert the pre-calculated Perspective Weight (SPW) to 10 - SPW value. The purpose of this conversion is to obtain an optimal and consistent spatial value, the perspective weight conversion formula by the following equation (Yusianto et al., 2021):

$$S_i = 10 - SPW_i$$

Where:
S = Spatial perspective weights convert results;
SPW = Spatial perspective weights;
S = SPW conversion value;
i = Alternate number.

The purpose of this conversion process is to obtain optimal and consistent spatial values.

6. Calculating the point distribution using the Center of Gravity (CoG) method from a spatial perspective
previously the basic formula for CoG is the following equation (Sosa-Terrazas et al., 2018):

$$\overline{X} = \frac{\sum_i V_i R_i X_i}{\sum_i V_i R_i}, \overline{Y} = \frac{\sum_i V_i R_i Y_i}{\sum_i V_i R_i}$$

Where:
Vi = Volume flowing from (to) point I
Ri = Transportation rate to ship Vi from (to) point i
Xi,Yi = Coordinate points for point i
$\overline{X}, \overline{Y}$ = Coordinate points for facility to be located

In this study, the addition of spatial perspective (Si) still uses the coordinates of each point (di) and capacity (R). The addition of spatial perspective (Si) to the CoG equation is carried out with the assumption that the effect of volume or capacity (Vi) is equivalent to spatial (S). Then the proposed COG equation formula is as follows:

$$\overline{X} = \frac{\sum_{i=1}^{n} (V_i + S_i)\ R_i\ X_i}{\sum_{i=1}^{n} (V_i + S_i)\ R_i}$$

At this stage the calculation of latitude coordinates (X); was calculated in the same way to get longitude coordinates (Y) then to get the value of $\bar{Y}$ use the following formula:

$$\overline{Y} = \frac{\sum_{i=1}^{n} (V_i + S_i)\ R_i\ Y_i}{\sum_{i=1}^{n} (V_i + S_i)\ R_i}$$

Where:

Vi = volume flowing from (to) point I
Ri = transportation rate to ship Vi from (to) point i
Si = Spatial Variabel
Xi,Yi = coordinate points for point i
$\bar{X}$,$\bar{Y}$ = coordinate points for facility to be located

However, the optimal location can be found with the right center of gravity method, therefore this research will adopt the use of the Exact Center of Gravity Method formula and with a spatial approach, the proposed CoG formula is as follows:

$$\overline{X} = \frac{\sum_{i=1}^{n} (V_i + S_i)\ R_i\ X_i / d_i}{\sum_{i=1}^{n} (V_i + S_i)\ R_i / d_i} \quad \overline{Y} = \frac{\sum_{i=1}^{n} (V_i + S_i)\ R_i\ Y_i / d_i}{\sum_{i=1}^{n} (V_i + S_i)\ R_i / d_i}$$

Where:

Vi = volume flowing from (to) point I
Ri = transportation rate to ship Vi from (to) point i
Xi,Yi = coordinate points for point i
$\overline{X}, \overline{Y}$ = coordinate points for facility to be located

Meanwhile, the value of d is obtained from the following formula (Sosa-Terrazas et al., 2018):

$$d_i = \sqrt{(X_i - \overline{X}^n)^2 + (Y_i - \overline{Y}^n)^2}$$

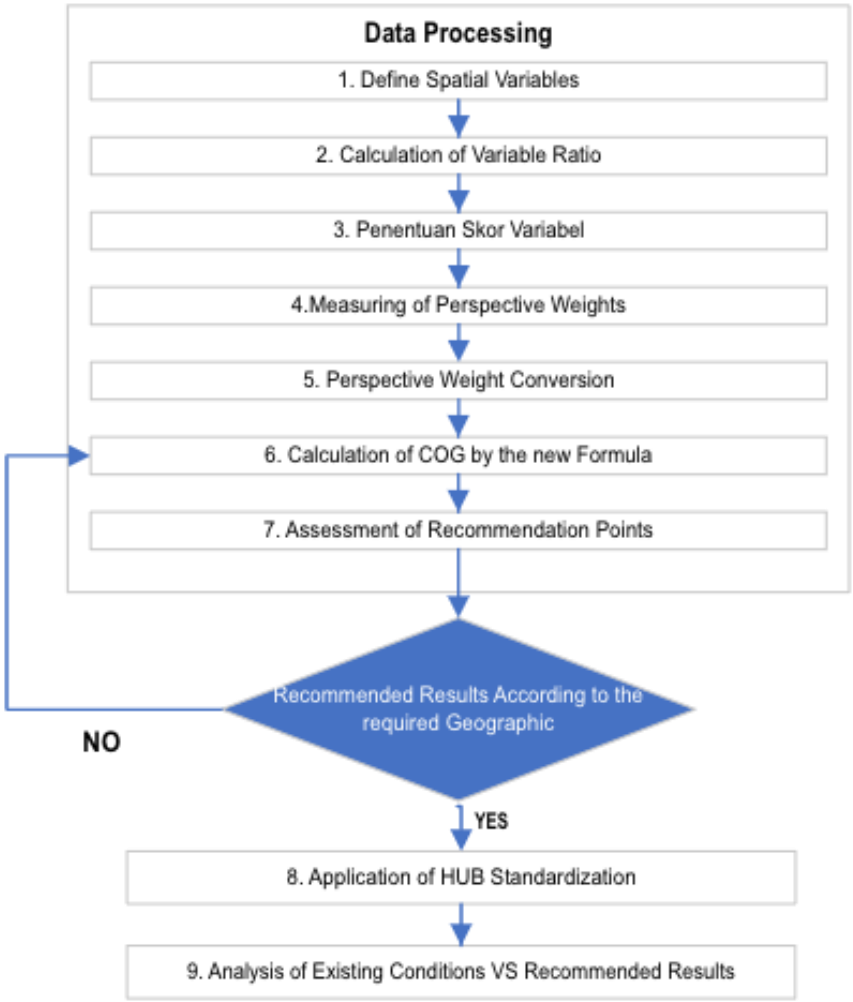
where the n value in the formula is the iteration number of the formula.

7. Assessing the recommendation points to adjust operational needs such as viewing the designation of these recommendation points for local land use by utilizing the National Spatial Information System (Sitarunas) website which can be a guide for achieving development targets in the long term within a certain scope.

8. Implementing of Standardization MS2400 halal logistics in the Transportation and Warehouse modules such as handling procedures, human resource management planning, location of goods placement, and minimizing product contamination.

9. Analyzing Sensitivity of Existing Conditions VS Recommended Results and then comparing CoG Classic Model and the Spatial CoG Model from identifying previous problems by calculating the average shipping price from the previously existing conditions and comparing it with the delivery distance from the results of the recommendations from this study, by comparing the recommendations from the existing conditions. beforehand and compare it with the application of the CoG Classic method, it will be found differences and advantages from the application of the method that has been developed and implemented.

Picture 4: Research Flow



Source: Research, Author Analysis (2022)

Result and Discussion

1. Compilation of Partial Variables

The process of modifying the COG method is carried out by adding a spatial perspective, and then arrangement of spatial variables, such as temporal congestion, land prices, labor prices, risk hazard zones, safety, and topography.

2. Calculation of Variable Ratio

The next process is preparation of variable ratios to determine the percentage value of each variable, which is as follows:

Table 4: Ratio of Each Variable

SP	Daerah	Persentase
SP1	Congestion/R1	40%
SP2	Land Price/R2	15%
SP3	Labour Price/R3	15%
SP4	Risk Hazard Zone/R4	12,50%
SP5	Safety/R5	12,50%
SP6	Topography/R6	5%

Source: Author Analysis (2022)

3. Calculation of Variable Scores

The next process is the scoring variable, such as temporal congestion zones, land prices, labor prices, risky hazard zones, security, and topography.

a. Congestion zone variable data collection

Spatial-temporal congestion data was collected from observations via Google Maps with the estimated duration of traffic during peak hours, such as in the afternoon at 16.00-20.00 WIB with the following classification:

Table 5: Congestion Classification

Classes	*Level*	*Value*
Very Good	*Smooth*	4
Good	*Rather Smooth*	3
Rather Bad	*A Little Jam*	2
Bad	*Traffic Jam*	1

Sumber : Yusianto, et.al (2021)

The spatial value of the congestion variable at the point of origin for Tangerang Regency and Bekasi Regency is as follows:

Table 6: Data of Congestion Point of Origin for Tangerang Regency

Origins	*Destination*	*Classes*	*Value*
Tangerang Regency	Tangerang Regency	*Rather Bad*	2
	Kota Tangerang City	*Good*	3
	South Tangerang City	*Good*	3
	West Jakarta	*Rather Bad*	2
	Central Jakarta	*Rather Bad*	2
	South Jakarta	*Bad*	1

Source: Google Maps (2022)

Table 7: Data of Congestion Point of Origin for Bekasi Regency

Origins	*Destination*	*Classes*	*Value*
Bekasi Regency	Tangerang Regency	*Rather Bad*	2
	Tangerang City	*Bad*	1
	North Jakarta	*Bad*	1
	South Jakarta	*Bad*	1
	East Jakarta	*Bad*	1
	Bogor Regency	*Bad*	1
	Bogor City	*Bad*	1
	Depok City	*Bad*	1
	Bekasi Regency	*Bad*	1
	Bekasi City	*Bad*	1
	Karawang Regency	*Good*	3

Source: Google Maps (2022)

b. Data collection for flood hazard zone variables

The risk hazard zone data was taken from flood disaster data compiled from National/Regional Disaster Management Agency/BNPB Indonesia data related to the following classifications:

Table 8: Classification of Flood Zones

Classes	*Risk*	*Value*
Safe	0-5 location point	4
Medium	6-10 location point	3
Bad	11-30 location point	2
Very Bad	31-40 location point	1

Source: Author Analysis (2022)

Data on flood zones after being collected and classified based on regional zones are as follows:

Table 9: Flood Zone Data per Region

Zone	*Classes*	*Classes*	*Value*
Tangerang Regency	1	Good	4
Tangerang City	2	Good	4
Tangerang Selatan City	5	Good	4
North Jakarta	2	Good	4
South Jakarta	22	Bad	2
.zcEast Jakarta	11	Bad	2
Bogor Regency	13	Bad	2
Bogor City	23	Bad	2
Depok City	22	Bad	2
Bekasi Regency	15	Bad	2
Kota Bekasi City	39	Very Bad	1
Karawang Regency	17	Bad	1
Central Jakarta	1	Good	4
West Jakarta	5	Good	4

Source: Author Analysis (2022)

c. Topographic variable data collection

Topography is the study of the land surface. This term can also refer to conditions where the ground level is low, based on Van Zuidam (2016); Yusianto et al (2021) the average topography can be classified as follows:

Table 10: Zones based on topography

Classes	*Range*	*Value*
Very Good	<200	4
Good	200-499	3
Medium	500-1299	2
Bad	1300-2658	1

Source : Yusianto, et.al (2021)

The topographical data based on zones after being collected and classified based on regional zones are as follows:

Table 11: Zone Data Based on Topography

Zone	*Elevation*	*Classes*	*Value*
Tangerang Regency	28	Very Good	4
Tangerang City	26	Very Good	4
Tangerang Selatan City	64	Very Good	4
North Jakarta	4	Very Good	4
South Jakarta	70	Very Good	4
East Jakarta	71	Very Good	4
Bogor Regency	230	Good	3
Bogor City	209	Good	3
Depok City	116	Very Good	4
Bekasi Regency	35	Very Good	4
Kota Bekasi City	71	Very Good	4
Karawang Regency	29	Very Good	4
West Jakarta	3	Very Good	4
Central Jakarta	11	Very Good	4

Source : Google Earth (2022)

d. Economic Variable data collection

The economic variables are consisting of two indicators, such as land prices and local labor wage prices, land prices are calculated based on Geomapid.io data from the Ministry of Agrarian Affairs and Spatial Planning/National Land Agency (ATR/BPN) on the basis of land value zones (ZNT) per meters in a regency or city, while the classification of land zones per area are as follows:

Table 12: Classification of Land Value Zones

Classes	*Range*	*Value*
Very Good	Rp.500.000 - Rp. 2.000.000	4
Good	Rp. 2.000.000 - Rp.5.000.000	3
Medium	Rp. 5.000.000 - Rp. 10.000.000	2
Bad	>Rp.10.000.000	1

Source: Author Analysis (2022)

Following table are summary of land value zone data for each area in Jabodetabek.

Table 13: Land Value Zone Data

Zone	Land Value	Point	Value
West Jakarta	5.000.000-10.000.000	387	2
Central Jakarta	>20.000.000	259	1
South Jakarta	5.000.000-10.000.000	362	2
East Jakarta	10.000.000-20.000.000	266	1
North Jakarta	>20.000.000	206	1
Tangerang Regency	500.000-1.000.000	55	4
Tangerang City	2.000.000-5.000.000	121	3
South Tangerang City	2.000.000-5.000.000	340	3
Depok City	2.000.000-5.000.000	413	3
Bogor City	2.000.000-5.000.000	376	3
Bekasi City	2.000.000-5.000.000	712	3
Bekasi Regency	500.000-1.000.000	110	4
Bogor Regency	1.000.000-2.000.000	553	4
Karawang Regency	1.000.000-2.000.000	6916	4

Source: Geomapid.io (Ministry of ATR/BPN) (2022)

The labor wage indicator was taken from the relevant regional government decisions classified in the following table

Table 14: Data on Labor Wage Classification

Classes	*Range*	*Value*
Very Good	Rp.3.000.000-Rp.4.250.000	4
Good	Rp.4.251.000- Rp.4.400.000	3
Medium	Rp. 4.410.000-Rp.4.750.000	2
Bad	>Rp.4.750.000.	1

The following is a summary of labor wage data for each region in Jabodetabek in the following table:

Table 15: Data of Workforce Wages per Region

Zone	Minimum Labor Wage	*Classes*	Value
DKI Jakarta Province	Rp 4.452.724,00	Medium	2
Bekasi City	Rp 4.816.921,17	Bad	1
Bekasi Regency	Rp 4.791.843,90	Bad	1
Depok City	Rp 4.377.231,93	Good	3
Bogor City	Rp 4.330.249,57	Good	3
Tangerang City	Rp 4.285.798,90	Good	3
South Tangerang City	Rp 4.280.214,51	Good	3
Tangerang Regency	Rp 4.230.792,65	Very Good	4
Bogor Regency	Rp 4.217.206,00	Very Good	4
Karawang Regency	Rp. 4.791.843,90	Bad	4

Source: Kontan.id Portal (2022)

e. Collection of crime rate zone variable data

The security variable was taken from the regional crime rate based on the Polda Metro Jaya report which is classified in the following table

Table 16: Crime Level Classification Data

Classes	*Range*	*Value*
Very Good	900-1200	4
Good	1201-1500	3
Medium	1501-2000	2
Bad	>2000	1

Source: Author Analysis (2022)

The following is a summary of the crime rate variable zone data for each area in Jabodetabek in the following table:

Table 17: Regional Crime Rate Data

Zone	Crime Number	*Classes*	*Value*
West Jakarta Barat	1879	Medium	2
Central Jakarta Pusat	2473	Bad	1
South Jakarta Selatan	1747	Medium	1
East Jakarta Timur	1340	Good	3
North Jakarta Utara	1387	Good	3
Tangerang Regency	1380	Good	3
Tangerang City	953	Very Good	4
South Tangerang City	1402	Good	3
Depok City	2196	Bad	1
Bogor City	1364	Good	3
Bekasi City	2934	Bad	1
Bekasi Regency	1320	Good	3
Karawang Regency	1425	Good	3
Bogor Regency	1504	Medium	2

Source: Polda Metro Jaya; Central Agency of Statistics (BPS) (2019)

4. Spatial Perspective Weight Calculation

The next process is calculating the spatial perspective weight (SPW) based on the Ratio (R) and Spatial Variable (SV) that have been determined previously. The calculation of the spatial perspective weight (SPW) uses the following equation (Yusianto et al., 2021):

$$SPW_i = \Sigma\, R_{iv} \times SV_{ij}$$

Where:

SPW = Spatial perspective weights;
SV = Spatial variables;
R = The ratio of each spatial variable;
i = Alternate number;
j = Number of spatial variables.

The ratio with a total percentage of 100% of all spatial variables, the ratio of spatial variables is as follows:

Table 18: Ratio of Each Variable

SP	Daerah	Persentase
SP1	Congestion/R1	40%
SP2	Land Value/R2	15%
SP3	Labor Cost/R3	15%
SP4	Risk Hazard Zone/R4	12,50%
SP5	Safety/R5	12,50%
SP6	Topography/R6	5%

Source: Author Analysis (2022)

5. Perspective Weight Conversion

The next process is to change or convert the spatial perspective weight (SPW) with 10 - SPW value. The purpose of this conversion to get optimal and consistent spatial values. The data processing conversion perspective weight (Si) is as follows:

Table 19 : Conversion results of spatial weight (Si) DC 1 Tangerang Zone

Location	*Total Value*	Total Percentage	*Conversion*
Tangerang Regency	21	3,085	6,915
Tangerang City	19	2,3	7,7
South Tangerang City	20	2,885	7,115

Source: Author Analysis (2022)

Based on table 19, the spatial calculation results for DC 1 Tangerang Raya state that Tangerang Regency had a spatial value (Si) of 6.915, while Tangerang City has a spatial value (Si) of 7.7 and South Tangerang City has a value of 7.115.

Table 20: Conversion results of spatial weight (Si) DC 2 Jakarta Zone

Location	*Total Value*	Total Percentage	*Conversion*
West Jakarta	16	2,07	7,93
Central Jakarta	14	1,805	8,195
North Jakarta	15	1,535	8,465

Source: Author Analysis (2022)

Based on table 20, the spatial calculation results for DC 2 Jakarta state that West Jakarta City has a spatial value (Si) of 7.93, Central Jakarta City has a spatial (Si) value of 8.195 and North Jakarta City has a value of 8.465.

Table 21: Conversion results of spatial weight (Si) DC 3 Jakarta Zone

Location	*Total Value*	Total Percentage	*Conversion*
South Jakarta	12	1,575	8,425
East Jakarta	13	1,355	8,645
North Jakarta	15	1,535	8,465

Source: Author Analysis (2022)

Based on table 21, the spatial calculation results for DC 3 Jakarta state that South Jakarta City has a spatial value (Si) of 8.425, East Jakarta City has a spatial value (Si) of 8.645 and North Jakarta City has a value of 8.465.

Table 22 : Conversion of spatial weight (Si) DC 4 Bogor Zone

Location	*Total Value*	Total Percentage	*Conversion*
Depok City	14	2,075	7,925
Bogor City	15	2,085	7,915
Bogor Regency	13	1,82	8,18

Source: Author Analysis (2022)

Based on table 22, the results of spatial calculations for DC 4 Bogor Raya state that Depok City has a spatial value (Si) of 7.925, while Bogor City has a spatial value (Si) of 7.915 and Bogor Regency has a spatial value (Si) of 8.18.

Table 23 : Conversion of spatial weight (Si) DC 5 Bekasi Zone

Location	*Total Value*	Total Persentage	Conversion
Kota Bekasi	11	1,485	8,515
Kabupaten Bekasi	15	1,855	8,145
Kabupaten Karawang	16	2,365	7,635

Source: Author Analysis (2022)

Based on table 23, the spatial calculation results for DC 5 Bekasi state that Bekasi City has a spatial (Si) value of 8.515, while Bogor Regency has a spatial (Si) value of 8.145 and Karawang Regency has a spatial (Si) value of 7.635.

6. Calculation of Center of Gravity (CoG)

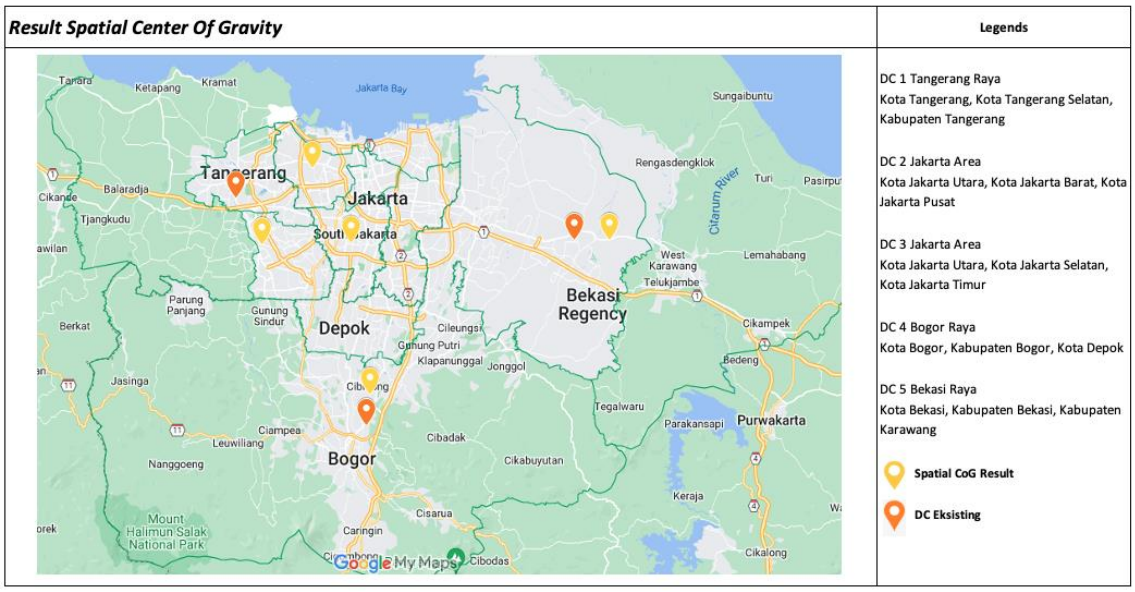
The next process is to calculate the Center of Gravity (CoG) from a spatial perspective. The proposed formula for CoG with a spatial approach, while the results of calculating the Center of Gravity (CoG) from a spatial perspective using the proposed formula are as follows:

Table 24 : Result of Spatial Center of Gravity (CoG)

Location	*Longitude (Y)*	*Latitude (X)*
DC 1 Tangerang Raya	-6,2801	106,66848
DC 2 Jakarta Area	-6,16544	106,74658
DC 3 Jakarta Area	-6,2765	106,80387
DC 4 Bogor Raya	-6,51985	106,83413
DC 5 Bekasi Raya	-6,27263	107,1993

Source: Author Analysis (2022)

Picture 5: Recommendation Results



Source: Research, Author Analysis (2022)

7. Assessment of Recommendation Points

The next process is assessment of the recommendation points that are adjusted by operational needs such as checking the recommendation points for local land use in the Website of National Spatial Information System (Sitarunas) and by checking at the effect of accessibility of recommendation point that should be accessible by collector roads, if we found that are not optimal, another alternative was given by shifting the coordinates of the hub with the furthest distance of 700 meters from the point of origin calculated by the Spatial Center of Gravity method, this shift was called Z1 and Z2.

The following is an assessment of the recommendation point and the shift in the recommendation point (Z):

8. Implement Standardization of MS2400 halal logistics standard

The selected location will be considered using the Halal Logistics Malaysian Standard (MS2400) in Section 2 of General Warehousing Requirements Article 7.1 regarding Warehouse Locations: Companies/organizations should consider potential sources of contamination when deciding on warehouse locations to protect halal integrity. The warehouse must reduce or be kept away from various things as follows:

a. Environmentally polluted industrial areas and activities that pose a serious threat
b. Flood affected areas
c. Pest attack area
d. Areas where waste, whether solid or liquid, cannot be effectively removed.

All the points that become recommendations from the results of this study are residential areas which are mostly free from environmental pollution that poses a serious threat, while

the area variables affected by flooding have been calculated using the spatial variables of disaster areas by determining the number of flood points. pest infestation was not considered in this study and areas where waste solid or liquid, could not be removed effectively were also not considered in this study. The layout recommendations from the application of the MS:2400 standard are included in Appendix A.

Table 28 Assessment of Recommendation Points Results from Using the CoG Spatial Method

Treatment	*Location*	*Longitude (Y)*	*Latitude (X)*	*Distance (KM)*	*Existing (KM)*	*Efficiency (%)*
Existing DC	DC Tangerang – Zona DC 1	-6,209892	106,6290	34	34	-
	DC Tangerang – Zona DC 2	-6,209892	106,6290	23,2	23,2	-
	DC Bekasi – Zona DC 3	-6,262150	107,1461	74,6	74,6	-
	DC Bekasi – Zona DC 4	-6,262150	107,1461	41,6	41,6	-
	DC Bekasi – Zona DC 5	-6,262150	107,1461	81,9	81,9	-
Average				*255,3*		
Classical CoG	DC 1 Tangerang Raya	-6,28122	106,6683	13,60	34	42,9%
	DC 2 Jakarta Area	-6,16415	106,7408	20,20	23,2	6,9%
	DC 3 Jakarta Area	-6,28051	106,8040	30,80	74,6	41,6%
	DC 4 Bogor Raya	-6,50224	106, 833	40,60	41,6	1,2%
	DC 5 Bekasi Raya	-6,27448	107, 206	40,50	81,9	33,8%
Average				*145,7*		25,3%
Spatial CoG	DC 1 Tangerang Raya	-6,2801	106,66848	13,80	34	42,3%
	DC 2 Jakarta Area	-6,16544	106,74658	20,00	23,2	7,4%
	DC 3 Jakarta Area	-6,2765	106,80387	29,40	74,6	43,5%
	DC 4 Bogor Raya	-6,51985	106,83413	40,20	41,6	1,7%
	DC 5 Bekasi Raya	-6,27263	107,1993	39,30	81,9	35,1%
Average				*142,7*		25,998%
CoG Shifted to Z1	DC 1 Tangerang Raya	-6,27893	106,66622	14,6	34	40%
	DC 2 Jakarta Area	-6,16483	106,74817	19	23,2	10%
	DC 3 Jakarta Area	-6,27567	106,80044	28,3	74,6	45%
	DC 4 Bogor Raya	-6,52011	106,83507	40,1	41,6	2%
	DC 5 Bekasi Raya	-6,2702	107,17876	38,1	81,9	37%
Average				*140,1*		26,640%
CoG Shifted to Z2	DC 1 Tangerang Raya	-6,27924	106,6709	15,2	34	38%
	DC 2 Jakarta Area	-6,16525	106,74558	19,9	23,2	8%
	DC 3 Jakarta Area	-6,27906	106,80783	29,4	74,6	43%
	DC 4 Bogor Raya	-6,5193	106,83051	39,8	41,6	2%
	DC 5 Bekasi Raya	-6,27088	107,19686	38,2	81,9	36%
Average				*142,5*		25,585%

Source: Research, Author Analysis, 2022

The use of the spatial Center of Gravity method for this research does not produce significant efficiency compared to using the Classic Center of Gravity method. When compared to previous studies in the study of (Yusianto et al., 2021), this indicates several possibilities which are summarized in this study, namely:

1. Determination of less significant spatial variables as found in the observation of the less significant topographic variable values within the scope of delivery for Jabodetabek and

Karawang Regency, because the topography in the Jabodetabek and Karawang areas tends to be very sloping.

2. The distance between demand is close to each other so it affects the costs incurred when shipping, different from previous research (Yusianto et al., 2021) where shipping is carried out at a longer distance.

The distribution of travel patterns for fresh food e-commerce products, both B2B and B2C products, mostly goes to residential areas because residential areas are the dominant consumers. 700 meters away from the Spatial Center of Gravity calculation result point due to the lack of access to the secondary collector road needed.

The implementation of Halal Logistics Standardization is considered to have an impact on product quality, but the application of this standard has several points that are considered quite important in the implementation process, based on the results of interviews with practitioners in the logistics sector which were held on July 30, 2022, the following views were obtained:

1. Investment costs (Capital Expenditure/Capex) are very large, causing the company to focus on long-term use.
2. The level of market urgency that is not high causes companies that are focused on the national market to re-identify potential customers.
3. The advantages of implementing halal logistics standards are gaining high trust from consumers and also being able to directly form core values within the internal company.

The author's response regarding the implementation of halal logistics standards is as follows:

1. Clauses to ensure transportation operations including agents and/or outsourcing parties that must comply with legal and halal requirements, which implementation is only based on the principle of trust or trust so that periodic audits are needed on external organizations.

2. The clause on the principle of product traceability is still difficult for the sender/distributor to carry out due to the absence of a global system capable of integrating data from upstream to downstream, therefore an integrated system is needed so that if a contaminated product is found it will be easy to trace and carry out improvements so that its application is only very possible by involving the role of regulators (government) to provide a separate database for the blockchain traceability process of halal products.

Conclusion

Based on the results of the research that has been done, it can be concluded as follows:

1. After identification using a spatial approach to the variables of congestion, natural disasters (with a tendency to flood), topography, economy (including land prices and labor prices), and security in each zone, the most optimal hub points are found as follows:

a. Zone DC 1 Tangerang Raya
Based on the results with 2 iterations, it was found that the X Bar (latitude) point was -6.28010394, while the Y Bar (longitude) point was 106.6684829.

b. Zone DC 2 Jakarta
Based on the results with 2 iterations, it was found that the X Bar (latitude) point was -6.16544047, while the Y Bar (longitude) point was 106.7465847.

c. Zone DC 3 Jakarta
Based on the results of 2 iterations, it is found that the X Bar point (latitude is -6.276778805, while the Y Bar (longitude) point is 106.8042899.

d. Zone DC 4 Bogor Raya
Based on the results of calculations with 2 iterations, it was found that the X Bar (latitude) point was -6.503629112, while the Y Bar (longitude) point was 106.8340035.

e. Zone DC 5 Bekasi Raya
Based on the calculation results with 2 iterations, it was found that the X Bar (latitude) point was -6.27263103, while the Y Bar (longitude) point was 107.19930662.

2. Application of Halal Logistics standards based on the results of interviews from practitioners and the author's perspective, such as investment costs (Capital Expenditure/Capex) which are very large then the level of urgency from the consumer side is not high, but the advantage is getting high trust from consumers and also this standard can directly form core values within the company's internal, on the one hand, its application to external parties of the company which is only based on the principle of trust requires periodic audits and product traceability processes which are still difficult for senders/distributors to outsiders due to the absence of a system capable of integrating data throughout the handling process from upstream to downstream.

3. Various additional rooms required in the recommendation layout process are locations for medical daily checkups, locations for prayer rooms and cleaning facilities, locations for hygienic toilets and employee lockers, locations for vehicle servicing processes, locations for vehicle unloading docks, locations for inbound goods inspection, location of the putaway process, location of sorting before the storage process, location of outbound quality inspection, location of contaminated goods separated from other goods, location of sorting and packing of goods, and location of the outbound loading dock of goods.

4. Logistics service providers should start for looking at the market potential for halal products in Indonesia as the largest Muslim country in the world, Then, regulator government should provide more implementable regulations regarding the halal logistics management process and start building a halal ecosystem in Indonesia, it is

expected to build an IT-based integrated system for the exchange process and hold structured and systematic dissemination of halal product guarantees.

Acknowledgment and Limitation

Acknowledgment

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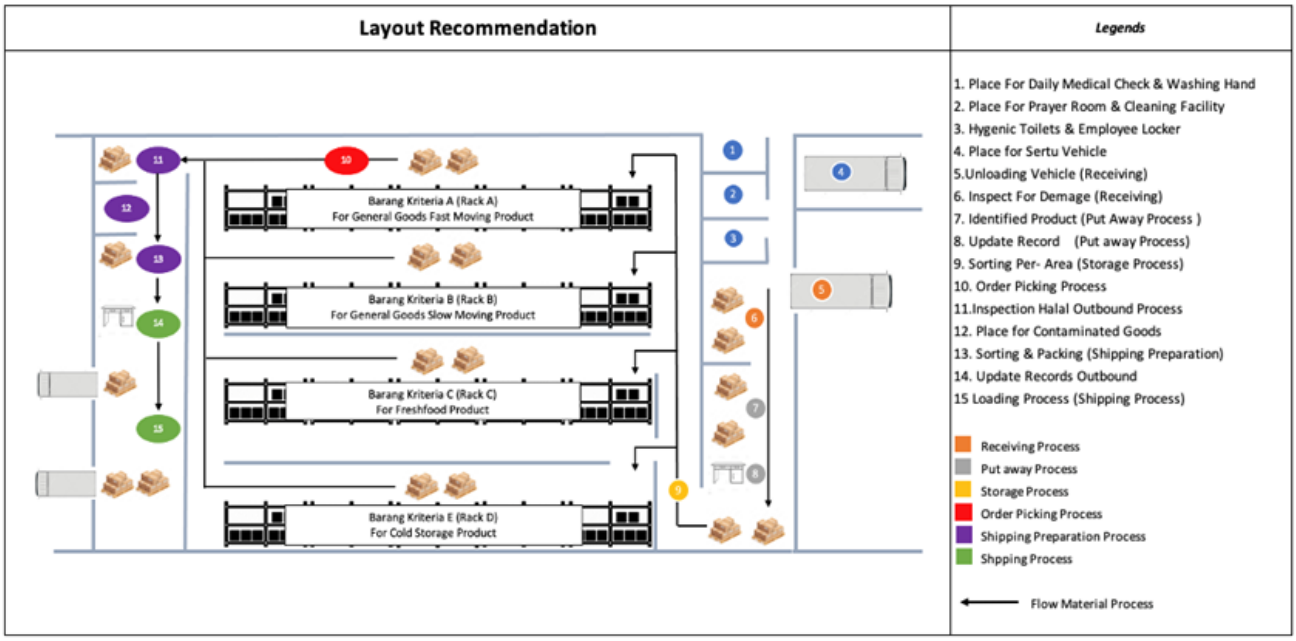
Limitation

Based on a sensitivity analysis study, it was found that the use of the proposed spatial Center of Gravity method did not have a significant impact compared to the application of the classic center of gravity method in the same research area, based on observations of journals that had almost the same studies, had significant differences, This is due to the variables that are less significant in influencing the problem of delivery distribution, such as topographical variables.

The weakness of using the Center of Gravity method that it does not take into account the Distance Barriers in Determining the Route to the Destination Point because it only focuses on the distance of the longitude and latitude points on the map, therefore it is necessary to collaborate between the use of the center of gravity method and for determining routes using other methods such as the nearest neighbor method, the Shortest Path Problem method or with other route determination methods.

Based on the results of interviews with executives in the field of logistics, it was stated that the implementation of standardized halal logistics using the MS2400 approach was still quite expensive to apply, therefore future research is expected to be able to carry out an analysis of the costs of implementing these standards or to compare the costs of implementing similar halal standards from various country.

Appendix A : The layout recommendations from the application of MS:2400



Source: Author Analysis (2022)

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