Analysis Of Location Selection Using Center Of Gravity Method For Production Optimization (Case Study Of Sumedang Saribumi Karawang Tofu Factory)

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ABSTRACT

Determining the location of the factory is an important element so that the factory continues to develop and operate. The Sumedang Saribumi Karawang tofu factory has problems in the production process, during the continuous rainy season the factory experiences flooding so it has to close production and experiences increased transportation costs due to the distance between the factory and several distributors. relatively high operational cost barriers of IDR 43,650,000 per year. So, when selecting the right location it is necessary to avoid obstacles in the production process. Therefore, it is important to select a location using the Center Of Gravity method. Based on previous research, the Center of Gravity can produce distribution centers based on the location of the location to be addressed and the volume of delivery so as to produce optimal locations and the distribution process can be effective and efficient. This research method uses a quantitative descriptive approach with Center Of Gravity calculations. By conducting observations and interviews and collecting some of the document data needed for the research. The research results show the optimal location of the factory with coordinate points X (–6.418306, 107.388306). namely in the Cimahi, Klari, Karawang Regency areas. The total reduction in distance resulting from this research was reduced by 4 km. By reducing the total distance traveled, transportation costs will also be smaller. The location of the Sumedang Saribumi Karawang tofu factory which has been suggested is at several distributor locations and also the newest location tends to not experience flooding with the location being in an area with a good drainage system that can drain rainwater quickly and efficiently thereby reducing the risk of flooding. So the current location is an advantage that can be utilized by the Sumedang Saribumi Karawang tofu factory because the distribution process is the key to the success of distribution activities.

Keywords: Center Of Gravity, Optimization, Location Strategy

INTRODUCTION

Indonesia is a developing country, Indonesia has an industrial sector spread across several cities or districts. The industrial sector plays an important role because it has a significant impact on regional economic development because the industrial sector can increase the number of jobs for the community, thereby alleviating poverty in each region (Nurhayani, 2022). Based on data from the Central Statistics Agency of the Republic of Indonesia, it is reported that the largest contributor to economic growth in 2023 is the processing industry with a share of 18.67% (BPS RI, Indonesian Economic Growth, 2024). MSMEs also have a role in the national economy, one of which is in the processing industry. The potential for MSMEs in Karawang Regency is very large in the culinary sector. Culinary can be said to be a lifestyle, inseparable from its main function of meeting people's food needs.

One of the MSMEs in Karawang Regency is mostly engaged in the culinary sector. One of them is Sumedang Saribumi Karawang tofu. MSMEs operating in the tofu industry are also carried out by residents in the West Karawang District, Karawang, West Java.

One of the problems faced by MSMEs in the Sumedang Saribumi Karawang tofu processing industry is the problems faced related to location strategy. The problem is that the Sumedang Saribumi Karawang tofu factory has a less strategic location, the factory location is close to the Karawang Citarum river, so when the rainy season occurs periodically, the factory is flooded, because the Citarum river is unable to accommodate rainwater and also requires a new production warehouse. close to agents spread across several points so that the distribution process can be effective in the costs incurred so as to obtain large profits and maximize income profits from the new business location. In 2020, the Sumedang Saribumi Tofu Factory experienced production closures for 14 days, in 2021 for 9 days, in 2022 for 7 days, in 2023 for 7 days and the Sumedang Saribumi Karawang tofu factory also experienced an increase in transportation costs of IDR 43,650,000 per year in 2023.

So a solution is needed so that transportation costs are not that big. One way that might be a solution to reduce distribution operational costs is to create a new distribution warehouse location. To select a new location, you must choose the right location so that it is suitable so that it does not result in high distribution operational costs. Therefore, an appropriate method is needed to provide a solution for selecting a location for a new production warehouse.

This research uses a description of the distribution method, namely using the Center Of Gravity Method. According to (Ruwiyanto et al., 2021) Center of Gravity (CoG) Techniques is a mathematical technique used to determine the location that can produce the best location for a single point that can determine several locations. According to (Ruwiyanto et al., 2021) by using the Center of Gravity Method, in the results of his research we can find out the distribution center based on the location of the city we are going to, so that delivery in the distribution process is not too far and this can save shipping costs, because the short distance can streamline delivery time.

Based on several previous studies regarding location strategies using the Center of Gravity, it is considered effective, for example in research conducted by (Iqbal et al., 2020), in his research the Center of Gravity can produce optimal locations and with the location of the new warehouse it can minimize transportation costs by IDR 481,192 with a decrease percentage of 6.76%. As for what was done by (Agianto et al., 2022), the result was that using the Center of Gravity Method resulted in the location of the distribution center -6.653153379 and 107.5731519 which was located in Karangpedes Village, Kiarapedes District, Purwakarta Regency with a total distance

reduction of 145.43 Km so that it could distribute products to customers quickly according to the agreed time, quantity and conditions.

Therefore, based on the background of previous problems and theories, this research focuses on optimizing production by selecting a location at the Sumedang Saribumi Karawang tofu factory, so that research can be formulated regarding "Analysis of Location Selection Using the Center of Gravity Method in the Context of Production Optimization (Study) Case of Sumedang Tofu Factory, Saribumi Karawang). The aim of this research is to find out, analyze and understand the implementation of the Center of Gravity method in selecting a location for the Sumedang Saribumi Karawang tofu factory.

METODE

In this research, the type of research that will be used is quantitative research. Because this research aims to find a common ground between what is recorded in theory and the reality in the field, this research uses a quantitative approach method. By collecting data in the field by conducting interviews with business owners and consumers in Sumedang Saribumi Karawang to find out what factors can influence the choice of business location, so that the data obtained can be processed and analyzed to obtain scientific information.

Sample

According to (Sugiyono, 2019) The sample is part of the population that is the source of data in research, where the population is part of the number of characteristics possessed by the population. The sample used in this research is the distance between distributor locations and strategic locations. The sampling technique used in this research was carried out using a snowball sampling case study. Because this research is only a case study, the interviews were taken from one company, but several samples were taken from the respondents so that there were many interview results from several sources to validate the data. The reason for using the snowball sampling technique is to make several considerations or certain criteria that must be met by the sample to be used in the research.

Data collection

In this research, the data collection method is by direct observation by conducting field studies, observing, recording and documenting and seeing events or phenomena that occur in the environment. By direct observation and observing business locations in the field, observing whether the business location is close to infrastructure, close to the community environment, what is the target market and its competitors, then conduct interviews using a list of questions that are often mentioned generally during interviews. This interview was conducted by researchers with the owner of the Sumedang Saribumi Karawang tofu factory business to find out the considerations of business owners and researchers in determining the location of a new business. Literature study by analyzing literature that is relevant to the research topic. Literature study involves searching, selecting and evaluating various literary sources such as scientific journals, articles, books, research reports and other sources. This data collection method is used as a complement in getting answers about matters that are not yet clearly related to this research.

Data Analysis Technique

The data analysis technique used in this research is using descriptive analysis and calculations using the Center of Gravity method and assisted by using the POM-QM for Windows tools. By using descriptive analysis, the author can find out what will be researched, namely location

strategy. Description of data obtained through interviews by asking questions and making observations to obtain an in-depth and objective picture which is then analyzed to find out how to determine the location strategy.

Operasional Variabel

The operational variables in this research use location strategy variables, with sub-variables including location determining factors and transportation costs

RESULTS

The Sumedang Saribumi Karawang Tofu Factory is a processing industry that produces Saribumi tofu. Because it has distributors spread across several points. So determining the location is very important for the smooth running of the production process so that there are no obstacles such as production closures and increased transportation costs.

In determining the location of the factory you also need to look at building costs, employee salary costs, production operational costs and other fixed costs. Apart from cost, you also need to pay attention to aspects of the surrounding environmental conditions such as population density, traffic conditions and security conditions. Therefore The factory hopes to create a new factory with a more strategic location to facilitate and speed up the delivery process and also not experience increased transportation costs.The Sumedang Saribumi Karawang tofu factory uses the Center Of Gravity method to obtain a strategic location, so there are several coordinate points for distributor locations, namely as follows:

Tabel 1. Coordinate points and shipping volume

Lokasi	Titik Koordinat		Volume
Pasar Rengasdengklok	-6.165310	107.300760	200 Papan
Pasar Cikampek	-6.409104	107.428054	200 Papan
Rest Area KM 57	-6.367937	107.360339	500 Papan
Rest Area KM 62	-6.389120	107.395632	500 Papan
Sukatani, Purwakarta	-6.602730	107.428054	500 Papan

Source: Data processed, 2024

Based on Table 4.1, it shows that there are coordinate points and volumes of deliveries made to consumers, deliveries made to Rengasdengklok market with x coordinates -6.165310 and y coordinates 107.300760, Cikampek market with x coordinates -6.409104, and y coordinates 107.428054, with volume Delivery was only 200 boards because the distance was only 19 km for the Rengasdengklok market and 26 km for the Cikampek market, due to market conditions where there were not many transactions so they only sent according to market needs because they could still be reached for the next stage of delivery, then for delivery to rest areas. area KM 57 Jakarta-Cikampek Toll Road with x coordinates -6.367937 and y coordinates 107.360339, rest area KM 62 Jakarta-Cikampek Toll Road with x coordinates -6.389120 and y coordinates 107.395632, Sukatani, Purwakarta Regency with x coordinates -6.602730 and y coordinates 107.428054 with a delivery volume of only 500 boards with a distance of 12 Km for the KM 57 rest area of the Jakarta Cikampek Toll Road, 19 Km for the KM 62 rest area of the Jakarta-Cikampek Toll Road, 45 Km for Sukatani, Purwakarta Regency, due to busy market conditions to meet market needs So

it is necessary to send a large volume of shipments and to minimize transportation costs so that frequent deliveries do not occur because this can cause greater transportation costs.So calculations are needed using the Center Of Gravity equation formula as follows:

$$Cx = \frac{(-6.165310 \times 200) + (-6.409104 \times 200) + (-6.367937 \times 500) + (-6.389120 \times 500) + (-6.602730 \times 500)}{200+200+500+500+500}$$

$$= -6.418.312$$

$$Cy = \frac{(107.300760 \times 200) + (107.428054 \times 200) + (107.360339 \times 500) + (107.395632 \times 500) + (107.428054 \times 500)}{200+200+500+500+500}$$

$$= 107.388.302$$

From the results of the calculations above, it explains the location of the central coordinates which were produced by calculations using the Center Of Gravity Method formula which produces the X coordinate point -6,418,312 and the Y coordinate point = 107,388,302
Based on Table 1, calculations can be carried out using the POM-QM Tools using the Center Of Gravity formula as follows:

	Weight/# trips	x-coord	y-coord	X multiplied	Y multiplied
Pasar Rengasdengklok	200	-6,17	107,3	-1233,06	21460,16
Pasar Cikampek	200	-6,41	107,43	-1281,82	21485,62
Rest Area KM 57	500	-6,37	107,36	-3183,97	53680,15
Rest Area KM 62	500	-6,39	107,4	-3194,56	53697,8
Sukatani Purwakarta	500	-6,6	107,43	-3301,37	53714,05
Total	1900	-31,93	536,91	-12194,78	204037,8
Average		-6,39	107,38		
Weighted Ave (COG)				-6,42	107,39
Median	950			-6,39	107,4

Source: Data processed, 2024

Figure 1. Results of calculations using the
Center Of Gravity formula POM-QM tools

From the calculation results above, it explains the location of the central coordinates which were produced using the Center Of Gravity Method formula with the help of POM-QM Tools, namely X = -6.42 and Y = 107.39.

The calculation above shows that the smallest number X multiplied -1233.06 and Y multiplied 21460.16 is in the Rengasdengklok market because the result of multiplying the X coordinate and the Y coordinate at the Rengasdengklok market shows the distance is only 12 km and the X coordinate number is the larger the negative, the smaller the value of the number, and the largest number of X multiplied -3301.37 and Y multiplied is in Sukatani, Purwakarta Regency, because the result of multiplying the X coordinate and the Y coordinate in Sukatani, Purwakarta Regency shows a distance of only 45 km, so the coordinate number If the negative value is small, the larger the number value.
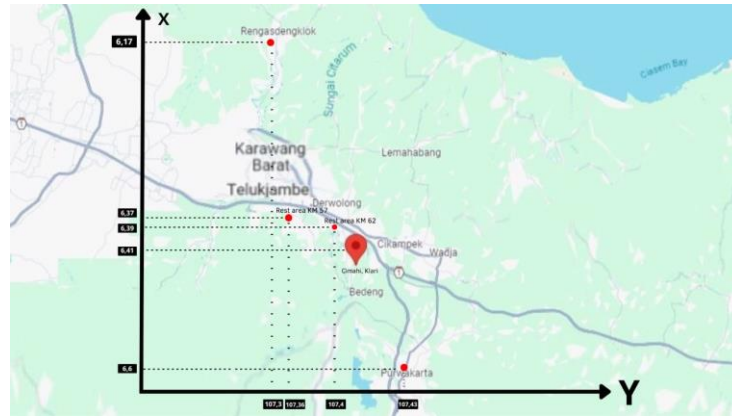
Figure 2. Suggested location coordinates

Based on the two calculations using the Center Of Gravity method formula, the coordinate values are obtained X=-6.418.312 dan Y=107.388.302 or are at coordinates 6°25′05.9"S 107°23'17.9"E. The location of these coordinates is in the Cimahi Village area, Klari District, Karawang Regency.

Discussion

Business location is one factor that can influence and play an important role. Determining a business location is closely related to several aspects that must be implemented. By aiming to determine the right business location, the company's operational processes can run smoothly, effectively and efficiently. With the results of calculations using the Center of Gravity formula, by producing the coordinate points obtained, they are then viewed using the Google Maps application, to find out the location points from the calculation results. The following are the recommended locations for the Sumedang Saribumi Karawang tofu factory.
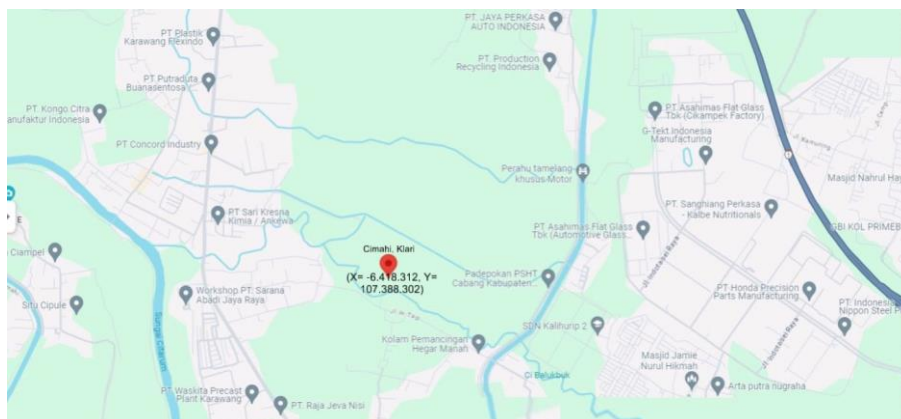

Figure 3. Recommended location areas

Based on Figure 4.2 seen via the Google Maps application, the location coordinates are in the Cimahi, Klari, Karawang Regency area. Based on direct site inspection, the location point is empty land and is close to the river bank. When determining the factory location, several factors must be taken into account, so that the factory location is determined correctly so that it can reduce production costs and provide other benefits. There are several considerations in determining the location of the Sumedang Saribumi Karawang Tofu factory.

Location factors need to be considered in determining business location. According to Dikdik Harjadi, (2015) in his book Introduction to Business Theory and Concepts. Determining location

is important for companies, because it will affect the company's position in competition and determine the company's survival. It is necessary to conduct research and observe the location area that will be chosen. So there are several factors that need to be considered, as follows:

1. primary factors
   a. Location of markets and sources of raw materials
      Based on the survey results that the location is close to the market or place where raw materials are purchased, if an industry is established close to the location where raw materials are purchased, the production process will be faster in the process of purchasing and making products.
   b. There are transport facilities
      Based on the results of an interview with Mr. Ruslan as Head of RT 014, he said that the location can still be reached by means of transportation. The location point can still be reached for product transportation, so that it can simplify the product distribution process.
   c. Labor availability
      Based on the results of interviews with Mr Ruslan as Head of RT 014, many people in this village do not have jobs, there are people who are ready to work but do not yet have jobs due to various factors. By establishing an industry that is able to absorb labor from the surrounding environment and provide new jobs, it can reduce the number of unemployed and improve the standard of living for the local population.
   d. Availability of electric power
      Based on the results of the location survey, it shows that the location is close to a power source, this power source can be used in the transmission and distribution of electric power to deliver electricity to load centers. According to (Widodo, 2023) electricity is the most suitable and comfortable form of energy for modern humans. With the growth in demand for electricity, plans must be made for the construction of new electricity centers. A factory will need electrical power for activities carried out in the factory such as running machines and lighting for the factory as a whole.

2. Secondary factors
   a. Future plan
      Based on the results of the location survey, the determination of future plans has been considered in terms of location, land availability and other needs that support production operations. The location of a factory needs to be designed regarding long-term planning so that it can be in accordance with the expectations of the factory owner for the continuation of the development of the tofu factory.
   b. The land price
      Based on an interview with Mr. RT, the empty land that will be used as a tofu factory covering an area of 800m2 is being sold for IDR 120,000,000.
   c. possibility of expansion
      Based on the location review, it shows that the business location is at the end of the rice fields close to the river bank and there is still empty rice field land available which can later be used for expansion if the factory progresses in the future.
   d. water availability

Based on the site inspection, it shows that the location area is close to the Kali Balukbuk river flow, because the tofu factory requires a river flow to make it easier to dispose of tofu waste directly through the river flow, it is necessary to build a factory with a river bank. Based on interviews with RT heads and local residents, they said that although this location was close to the riverbank, it did not experience flooding, because the area was not low-lying.

e. attitude of the people of the area

Based on the results of location surveys and interviews with the community, the community does not mind if a tofu factory building is built in Sumedang Saribumi Karawang, they do not feel disturbed by the noise of the machines from the tofu factory, because the machines used in the tofu factory are not too noisy, and The local community is also used to the industrial environment, because there are already several factories in that location.

Based on calculations using the Center Of Gravity formula, it can produce a more optimal location. The new factory location is closer to several agents. After the coordinates are obtained, the old factory location and the new factory location are compared with the total distance traveled from the factory to the consumer's location. The comparison results can be seen in the following table:

Tabel 1.2 Comparison of Previous Location Distance and Latest Location Distance

No	Location	Distance	
		Previous factory location	Newest factory location
1	Pasar Rengasdengklok	19 Km	40 Km
2	Pasar Cikampek	26 Km	12 Km
3	Rest Area 57 Tol Jakarta-Cikampek	12 Km	17 Km
4	Rest Area 62 Tol Jakarta-Cikampek	45 Km	21 Km
5	Sukatani Kabupaten Purwakarta	45 Km	27 Km
	Total	121 Km	117 Km

Source: Data processed, 2024

Based on the calculation results, the Sumedang Saribumi Karawang tofu factory can save a total distance of 4 km. By reducing the total distance, it is hoped that transportation costs will also decrease, because the two are directly proportional.

Tabel 1.3 Comparison before using
Center Of Gravity and after using Center Of Gravity

No	Information	Comparison	
		Before using Center Of Gravity	After using Center Of Gravity
1	Distance	121 Km	117 Km
2	Closing production period 2023	7 Days	0

| 3 | Production shutdown losses | -+ Rp 30.000.000 | 0 |
| 4 | Swelling transportation costs | Rp 43.650.000 | 0 |

Source: Data Processed, 2024

Tabel 1.4 Comparison of Losses and Gains

No	Disadvantages before using Center Of Gravity	Anticipation is not lost after using Center Of Gravity
1	Rp 73.650.000	Rp 73.650.000

Source: Data Processed, 2024

The location of the Sumedang Saribumi Karawang tofu factory which has been suggested is at several distributor locations, so the current location is an advantage that can be utilized by the Sumedang Saribumi Karawang tofu factory, because the distribution process is the key to the success of distribution activities, because after implementing location determination using the Center Of Gravity, it is very likely that the Sumedang Saribumi Karawang tofu factory can anticipate losses and thus gain a profit of IDR 73,650,000, by reducing the number of kilometers by 4Km thereby providing increased delivery speed, reduced transportation distance, savings in fuel costs, vehicle maintenance and other operational costs. can reduce logistics and distribution costs for companies. By reducing travel distances, productivity and operational efficiency can be increased.

The recommended location may not have any problems even though the location is close to the river but is above the river bank. So, it is very likely that it will not be affected by flooding, if the location is in an area with a good drainage system, it can drain rainwater quickly and efficiently thereby reducing the risk of flooding, because the area has a river flow that is not polluted by piles of rubbish, it can be used as a system. other flood control. So the new location that is produced can optimize the value of the location's benefits so that the obstacles that have occurred can be minimized at the new location, so in choosing a location using the Center of Gravity method it can produce effective and efficient location coordinates.

CONCLUSION

Several points that can be concluded in this research are that the implementation of the Sumedang Saribumi tofu factory selection process was to determine the location point by calculating the Center of Gravity to produce a new coordinate point X=-6.418.312 dan Y=107.388.302 or are at coordinates $6°25'05.9"S\ 107°23'17.9"E$. The location of these coordinates is in the Cimahi Village area, Klari District, Karawang Regency. Then, the author conducted a survey at the location that had been determined to find out various contexts for placing business locations so that they met the desired goals and criteria so as to produce optimal location points, Of all the factors that have been presented, there are several dominant factors that must be paid more attention to, namely factory land which is close to river water, because the tofu production process produces liquid waste which needs to be disposed of. Locations close to rivers can make it easier to dispose of waste, but you also need to pay attention to good management so as not to pollute

the river, and the comparison that occurs where the new location coordinate points can produce a more optimal alternative location, because the factors in determining the location according to the criteria are in accordance with the needs of the Sumedang Saribumi Karawang tofu factory in terms of land, transportation costs, environment and other productivity aspects. With the location that has been suggested, the current location is an advantage that can be utilized by the Sumedang Saribumi Karawang tofu factory, by reducing the number of kilometers by 4 km. Thus providing increased delivery speed, reduced transportation distance, savings on fuel costs, vehicle maintenance and other operational costs which can reduce logistics and distribution costs for companies.

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