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Utilization of Supply Chain and Benefit-Cost Analysis to Determining Warehousing Area in Penajam Paser Utara Regency

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Abstract— **The retail trade sector is currently booming and seizes unlimited opportunities and intersects with other sectors that can cause multi-fliyer effects to improve the regional economy, especially in the Expansion Regency. However, due to limited infrastructure and inefficient distribution, the price of goods is expensive. Although local governments have initiated through regulations and policies, they are not yet in synchronize to support the needs of the retail industry and consumers. From the preliminary study, Penajam Paser Utara (PPU) as a new expansion district needs to build facilities and infrastructure such as warehouses for retail products. This study aims to determine the feasibility of warehousing development with supply chain management analysis (SCM) and Benefits-Cost Ratio (BC). The results of the SCM analysis show that the vehicle operating costs for alternative location 1 is Rp.77,356 per km per unit; alternative location 2 is Rp.120,810 per km per unit; and alternative 3 is Rp.116,016 per km per unit. If the investment value is Rp.53,558,320,000 with an interest rate of 10.05%, then the value is equal to Rp.58,220,669,253 in the 40th year; BC=1.07; and EIRR=10.7%. The development of warehousing will provide benefits to local governments, communities, and business actors, including reducing the risk of damage to goods, reducing operational costs, transportation time, reducing road pressure/load, and providing input for local revenue in the management of warehousing services. This study also recommends the calculation results of SCM and financial confirmation, for the construction of retail warehousing around the Buluminung Industrial Estate which is placed between the port and the central business district. The Buluminung Industrial Estate has been designated by the local government as an industrial area supporting the PPU district's economy. The recommendation also states that the financial and economic perspective strongly supports the need to immediately build a retail warehouse.**

Keywords—Supply chain, Benefit-Cost Ratio, Warehouse

I. INTRODUCTION

The logistics industry is the main goal in the construction or development of warehouses to achieve work efficiency in the distribution of goods, and this is caused by an efficient logistics system that largely determines the development of the needs of people's lives. The distribution of goods, warehouse location, stall/outlet locations, and supply chain management (SCM) will determine and control the effectiveness of retail sectors from the industry, distributors, and stores to the end of consumers as the purpose of SCM is to satisfy consumer needs and generate of profits [1].

Efficient distribution of goods will lead to transportation costs, generally accounting for one-third to two-thirds of logistics costs [2]. The way to determine costs is to measure the position of the warehouse as a distributor centre to outlets/stores with optimal routes and transportation systems.

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Meanwhile, increasing the efficiency of transportation is urgently needed to optimize added value and decrease distribution costs. In line with [3] mentioned, it is stated that all supply chain management strategies are to organize, control, and improve, motivate all resources, and involve the flow of services and distribution of materials in the supply chain.

On the other hand, [4] defines SCM as an organization network that involves the relationship between upstream and downstream in the process and different activities yang provide value in the form of products and services to the consumers. Meanwhile, Stanford Supply Chain Forum argues that it is closely related to the flow of material, information, and financial management in the network of suppliers, industry, distributors, and consumers. Other experts, [5], mentioned that SCM is simply referring to the management of the entire set of production, distribution, and marketing processes by which a consumer is supplied with the desired product. Meanwhile, [6] argue that SCM is "... an integrative philosophy to manage the total flow of a distribution channel from supplier to the ultimate user." So SCM can be interpreted as inter-company coordination and business interactions related to products, services, financial resources, and information by creating an organized way to interact with each other in the supply chain.

The warehousing location determines the length and mode of transport time required to travel to the place of delivery. Therefore, choosing the right location indirectly reduces costs. The existence of road access can provide efficiency values during the development of warehousing areas [7].

Meanwhile, the theory of *Least Cost Location Weber* in Location Theory and Decision Analysis [8] explains that the optimum value is seen as primary. The theory takes a point where the cost of transporting the required raw materials and finished goods from the warehouse to the market is minimal. The main content of this theory is the place with the least cost. The principle of most minor cost location to obtain it needs to assume the following pre-conditions: (1) a uniform area in terms of topography, climate, and population; (2) easily accessible development resources and raw materials; (3) cheap labor wages; and low transportation costs and depends on the weight of the materials/goods being transported, as well as the distance between raw materials, finished goods and the location of the warehousing plan and easily accessible.

In his study, [9] expressed two hypotheses regarding the paradigm of choosing a warehousing location. First, it is determined by the size of the warehousing facility. Both are determined by changes over time. For example, warehouse built before the 1980s tend to take into account proximity to local markets, labour, ports and intermodal terminals. In the 2000s and above, land prices and the location of intermodal facilities tended to be more balanced. In line with this study, the findings [10] show that the main factors for moving warehousing areas to different locations are due to differences in land prices, lower taxes and better infrastructure. Meanwhile, [11] in their study critizes the direction of developing logistics facilities like this, which is increasingly moving away from production facilities due to consideration of land prices, thereby increasing delivery distance which actually have a negative impact on the environment due to the back and forth of heavy vehicles and the resulting emissions. In their conclusion, they suggested the existence of an integrated area between industrial and logistics facilities, such as the relationship between the warehousing areas and the industrial area.

The exixtence of a gap in the selling price of relatively expensive goods is caused by distribution patterns and infrastructure that is less supportive in the distribution of goods into the consumers. Therefore, this study will examine the establishment of warehousing as an effort to minimize this gap.

II. RESEARCH METHODOLOGY

This research starts from collecting secondary data through the direct method with a literature review. The data was obtained from the Department of Transportation, Warehouse Authority, the Port Authority, and the Container Authority of Samarinda. This data provided detailed information on the cost of rent, cost of goods distributions, and the capacity of model transportation that uses. Primary data was collected by survey in three different locations: Baluminung Industrial Estate, Port Area of Penajam Paser Utara, and upper area of port by the sea.

Data processing carried out in this research includes determining the coordinate's distribution centre and knowing the system route the most optimal transportation to the stalls or stores of Penajam City.

The logistics, economic, and financial analysis is used to determine the location's feasibility and how profitable the warehouse will be built. We used the logistics approach of the distribution supply chain, storage effectivity, and public-private partnership (PPP) scheme. The economic and financial approach also uses to analyze commodity risk, transportation, transport time efficiency, reduce road damage pressure or load, and provide income for original local Government revenue (PAD), Net present Value (NPV), Economic Internal Rate of Return (EIRR), and Benefit-Cost Ratio (B/C).

III. DISCUSSIONS

3.1 Economic Feasibility Analysis

From the economic aspect, the Warehousing Area development will benefit the government, the community, and people in business. These economic benefits include:

- Reduce the risk of damage to goods

  The further the goods are transported in the transport vehicle, the higher the risk of damage. During the process of transportation to loading and unloading, it can cause damage to the goods being transported. The damage itself can occur due to packaging defects, the sensitivity of goods to changes in temperature, friction between goods with one other, the load from the pile of goods on it, leaks, spills, or incorrect handling. The transfer of goods from the large warehouse to the distributor's transit warehouse will cause damage. The average damage to goods transported during the journey between the origins of delivery to Penajam is in the range of 1-5 percent. The development of warehousing areas that have shorter accessibility will reduce the level of damage to goods.

- Lowering the operational cost of transporting goods

  The farther the accessibility between the central warehouse and transit warehouse, the higher the operational costs. Delivery of goods using a rental truck from a third party requires substantial operational costs, including transport rental, trucks, and wages for loading and unloading goods.

- Transport time efficiency

  The distance between the loading and unloading terminal and the warehouse will determine the delivery time of the goods. The farther the distance travelled, the more transportation time required, and vice versa. Transport time will be directly correlated with the transportation costs and the risk of damage to the goods. The development of the warehousing area will shorten the distance so that the travel time of goods transportation will be more efficient.

- Reduce road damage pressure/load
  Transportation of basic needs using public roads has caused damage. Meanwhile, the development of the warehousing area is expected to reduce the road load for the transportation of goods passing through it. A decrease in road damage will correlate with road maintenance costs.

- Provide income for Original Local Government Revenue (PAD/OLGR)
  The development of the warehousing area with the assumption of a 5% contribution is predicted will contribute to PAD/OLGR in the third year. It is contribution will increase as tenants fill the building.

- To reduce the burden on tenants, parking fees are assumed to include warehouse rent. In the 3-7th year, if 29 warehouse units are rented out, the contribution will be Rp.1,596,000,000 per year. Between 8-12 years, warehouses filled with 42 units will contribute Rp.2,268,000,000 per year. The warehouse, filled with 57 units, will contribute Rp.2,946,720,000 per year between the 13th-20th year. In the year 21-30 warehouses filled with 64 units will contribute Rp.3,336,480,000 per year. The warehouse, filled with 84 units, will contribute Rp.4,058,880,000 per year were obtained in the 31st-40th year.

TABLE I. FORECAST OF WAREHOUSE RENT FOR REGIONAL REVENUE

Year of Rent	*Measurement (m2)*	*Filed (10Units)*	*Estimated receipt (Rp.)*	*Contribution to Regency 30% (Rp)*
Year 3-7	800	9	2.520.000.000	756.000.000
	512	10	1.792.000.000	537.600.000
	288	10	1.008.000.000	302.400.000
Subtotal		29	**5.320.000.000**	**1.596.000.000**
Year 8-12	800	12	3.360.000.000	1.008.000.000
	512	15	2.688.000.000	806.400.000
	288	15	1.512.000.000	453.600.000
Subtotal		42	**7.560.000.000**	**2.268.000.000**
Year 13-20	800	14	3.920.000.000	1.176.000.000
	512	20	3.584.000.000	1.075.200.000
	288	23	2.318.400.000	695.520.000
Subtotal		57	**9.822.400.000**	**2.946.720.000**
Year 21-30	800	16	4.480.000.000	1.344.000.000
	512	23	4.121.600.000	1.236.480.000
	288	25	2.520.000.000	756.000.000
Subtotal		**64**	**11.121.600.000**	**3.336.480.000**
Year 31-40	800	16	4.480.000.000	1.344.000.000
	512	28	5.017.600.000	1.505.280.000
	288	40	4.032.000.000	1.209.600.000
Subtotal		84	**13.529.600.000**	**4.058.880.000**

Sample of a Table footnote. *(Table footnote)*

3.2 Financial Feasibility Analysis

Financial analysis is carried out to find out the government's benefits from several capital expenditures (investments) launched to develop warehousing areas.

Investment Cost

Investment costs are costs incurred by local government in the form of land acquisition of 50 hectares (assuming; IDR1,000,000 per m^2), warehouse construction costs, environmental costs, providing supporting infrastructure, as well as obtaining permits and feasibility studies.

TABLE II. INVESTMENT USES

Descriptions	***Costs (Rp)***
• Land Clearing	50,000,000,000
• Cost of Warehouse Construction	2,486,200,00
• Cost of Environmental Arrangement	124,310,000
• Supporting Infrastructures	397,792,000
• Licensing Management and Feasibility Studies	550,000.000
Total	***53,558,302,000***

The above investment costs are further described in order of priority. In year 0 required an investment of Rp.39,444,500,000, consisting of material costs (civil works costs) and non-physical costs (in the form of land acquisition costs of 75% of the total land value) and preparation of Feasibility Study documents. The 1st year required Rp.13,331,700,000, consisting of material costs (in the form of main building construction work and canopy installation) and non-physical costs (in the form of land acquisition costs of 25% of the total land value. The 2nd year required Rp.782,102,000 consisting of physical cost (finishing work, installation cost for supporting infrastructure, and environmental management costs).

TABLE III. INVESTMENT COSTS ALOCATION

Year of Project	***Physical cost***	***Non- Physical cost***	***Cost (Rp)***
0 Year	1,394,500,000	38,050,000,000	39,444,500,000
1st Year	831,700,000	12,500,000,000	13,331,700,000
2nd Year	782,102,000	0	782,102,000
Total			**53,558,302,000**

Net Present Value (NPV)

The calculations with an interest rate of 1.52% obtained NPV>0 indicate that the development of the warehousing area is feasible to carry out. The investment value of Rp.53,558,320,000 at an interest rate of 10.05% will be equal in value to Rp.58,220,669,253 on year 40.

Economic Internal Rate Of Return (EIRR)

The estimated calculation of EIRR at a 10.05% bank interest rate and an investment value of Rp.2,486,200,000 will provide around a 10.7% rate of return in the 40th year.

TABLE IV. EIRR LEVEL AT YEAR-40

Year	***Net Benefit***	***DF 10,05%***	***NPV 10,05%***	***DF 11%***	***VPV 11% (Rp)***
0 Year	-39,444,500,000	1,0000	-39,444,500,000	1,0000	-39,444,500,000
1st Year	-13,332,700,000	0,9087	-12,114,220,809	0,9009	-12,010,540,541
3nd Year	-1,463,768,410	0,8257	-1,208,626,957	0,8116	-1,188,027,279
4rd Year	4,638,333,590	0,7503	3,480,100,928	0,7312	3,391,509,545
5th Year	4,636,333,590	0,6195	3,162,290,712	0,6587	3,055,414,004
40th Year	12,847,933,590	0,0217	278,760,611	0,0154	197,657,879
Total			**4,360,659,451**		**-2,108,050,454**

Ratio Benefit/Cost (B/C)

Based on analyzing B/C obtained NPV Negative as Rp.52.767.347.766,00 and NPV Positive as Rp.56.616.558.900,00 - B/C=1,07.

3.3 Operational Cost Analysis: Freight transport (Production dan Attraction)

The use of computer equipment is beneficial in the implementation, speed, accuracy of statistical calculations when analyzing the completion of goods transportation (production and attraction); this can be done by entering data obtained using the SPSS program where this program assists the completion of the formulation or modeling for the number of incoming and outgoing goods.

The modeling results (formulation) show that it is necessary to pay attention to the relationship of the dominant variable to this by looking at the value of the determination R^2 from several regression equations made [12]. The test used the regression method (linear regression) with one independent variable to determine the dominant variable for incoming goods and outgoing goods. A simple regression analysis (one variable) is performed. However, the SPSS program is used when there is more than one independent variable [12].

3.4 Goods Transport Formula/Model Anlysis

One of the criteria for selecting the best model is done by paying attention to the results of regression accuracy. A regression model that uses several independent variables and has a coefficient of determination R^2 close to 1.0 is preferable to using many variables but has a value that is not much different from the results of several variables.

Based on the test results by trying one variable or with several variables on incoming and outgoing goods in 4 districts in PPU Regency, the incoming and outgoing goods transportation model chosen is the independent variable is the number of residents, this is also by looking at the statistical test and logical factors and rages for the model. Based on the model selection from the regression (SPSS program), the freight transport model (production and attractions) is as follow:

TABLE V. PROGRAM OUTPUT

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	194.325	3192.307		.061	.961	-40367.779	40756.428
	Penduduk	.308	.050	1.004	6.186	.102	-.325	.941
	Karet	-4.785	3.116	-.249	-1.536	.367	-44.373	34.804
2	(Constant)	-2989.501	3145.775		-.950	.442	-16524.677	10545.674
	Penduduk	.293	.063	.956	4.632	.044	.021	.566

a. Dependent Variable: Barang Masuk

Model	Change Statistics				
	R Square Change	F Change	df1	df2	Sig. F Change
1	.975[a]	19.194	2	1	.159
2	-.060[b]	2.359	1	1	.367

a. Predictors: (Constant), Karet, Penduduk
b. Predictors: (Constant), Penduduk
c. Dependent Variable: Barang Masuk

The result of the formulation/equation of goods transport (production and attractiveness) selected are the population-independent variables as follow:

Goods in/out = - 2989,501 + 0,293 peoples. (1)

3.5 Analysis of Vehicle Operational Cost (OCA)

Vehicle Operational Cost Analysis (OCA) is transportation costs by vehicle (truck/boxcar), transporting goods from the warehouse to the market area (stalls/stores) [13].

The data for this transportation plan/analysis are as follows:

$$\text{Production of Boxcars (Q)} = \frac{V \times Fa \times 60}{Ds \times Cmt} \quad (2)$$

- Truck Carrying Capacity (V)=1,50 Ton
- Truck House Power (HP)=110 HP
- Work Efficiency Factor (Fa)=0,80
- Weight of material (D)= 0,8 Ton/m^3 (ca. 0,5 - 2,4)

Calculation of transport vehicles cycle time [14]

$$Cmt = \underbrace{T}_{\text{Load time}} + \underbrace{(D/V1)}_{\text{Distribute time}} + \underbrace{T1}_{\text{Unload time}} + \underbrace{(D/V2)}_{\text{Return time}} + \underbrace{t_2}_{\text{Lead ime}} \quad (3)$$

Were:

- Cmt = Transport Cycle Times (minutes)
- T = Loading time into the boxcars (minutes)
- D= Boxcars transport distance (m)
- V_1= Average speed loaded boxcars (m/min)
- V_2= Average speed empty boxcars (m/min)
- t_1 = Load time (minutes)
- t_2 = Lead time & Loading time take position (minutes)
- 1 work hours = 8 hour
- Total of items in the distributor of PPU =

= 37.000 ton/year (124 ton/day) (assumption 1 year 300 work hour)

1) Cost of Ownership (Fixed cost)

$$E = \frac{(B-C)(Da+0,002)}{W} \quad (4)$$

Were:

B = Price of Boxcar (new) = Rp300.000.000,-/Unit

C = residual value of Boxcar after expired (10% . B)

D_a = Payback factor

$$D_a = \frac{i(1+i)^A}{(1+i)^A-1} \quad (5)$$

W = Effective life of Boxcar (5 years)

i = 10%

$D_a = \frac{i(1+i)^A}{(1+i)^A-1} = \frac{0,10(1+0,10)^5}{(1+0,10)^5-1} =$ 0,161051/0,61051=0,264

$$E = \frac{(300.000.000,00-30.000.000,00)(0,264+0,002)}{1200} \quad (6)$$

= Rp59.850,-/hour

Cost of ownership = E = Rp59.850,-/Jam (7)

2) Operational Cost (K) per hour

- Fuel price = Rp6.500,-/litter
- Oil price = Rp35.000,-/litter
- Cost of petrol & oil = F = F1 + F2
- Spare part (G1) = 12,5 s/d 17,5%
- Workshop (G2) = 6,25 s/d 8,75%
- Price of Boxcars (B = Rp300.000.000,-/unit
- Working hours/year (W) = 1200 jam

$$\text{Maintenance (G)} = \frac{(G1+G2)}{W} \times B \quad (8)$$

$$G = \frac{(17.5+8,75)\%}{1200} \times Rp.300.000.000,00 =$$ Rp65.625/hours(9)

Operator (Driver) = H = Rp30.000/hour

Operator assistance (co-driver) = I = Rp17.000/hour

Total operational cost (K)/Unit Cars = F + G + H + I

K=184.250+65.625+30.000,00+17.000,00=Rp. 296.875,-/hour

Total Cost=E + K = 59.850 + 296.875 = Rp356.725,-/hour/unit.

Analysis of vehicles operational cost for location Alternative 1 – Distance 7,24 km

Assuming through the existing road (at this time) (distance ± 7,24 km = 7.240 m)

$$\text{Production of Boxcar (Q)} = \frac{V \; x \; Fa \; x \; 60}{Ds \; x \; Cmt} \quad (10)$$

- V = 1,50 ton
- Fa = 0,8
- Ds = 0,8
- Distance 7,24 Km

Were:

- T = 30 minutes (loading process)
- D = 7,24 Km = 7.240 meter
- V_1 = 50 Km/jam = ((50 x 1.000)/60) =833,33 m/minutes
- V_2 = 40 Km/jam = ((40 x 1.000)/60) =666,67 m/minutes
- t_1 = 30 minutes loading in warehouse) = 30 minutes
- t_2 = 15 minutes (lead time) = 15 minutes
- Cycle time (Cmt) = $T+D/V_1+t_1+D/V_2+t_2$
- Cmt= 30+(7.240/833,33)+30+(7.240/666,67)+15=94, 55 minutes = 1,57 Jam
- Cycle freight time = 1,57 Jam/unit Boxcars
- Production of Boxcars (Q) = $\frac{V \; x \; Fa \; x \; 60}{Ds \; x \; Cmt}$ = $\frac{1{,}5 \; x \; 0{,}8 \; x \; 60}{0.8 \; x \; 94.55}$ = 0,952 ton/hour
- Number of boxcars/day= 124 ton/day: 7,615 ton/day = 16,28 ∞ 17 unit.
- Unit Cost of Boxcars =1,57xRp.356.725,-=Rp. 560.058,25/unit/day
- Total Cost 17 Boxcars = Rp9.520.986,00/day.

Analysis of operational vehicles cost for location Alternative 2 – Distance 4,19 Km

Number of cars needed

Box/day=124 ton/day:8,455 ton/day =14,66 ∞ 15 unit.

Total cost 15 Boxcars = Rp7.592.891,625/day

Analysis of operational vehicles cost for location Alternative 3 – Distance –3,33 Km

Figure 1. Location information

Number of cars needed

Boxcars/day = 124 ton/day: 8,667 ton/day=14,307 ∞ 15 unit.

Total cost 15 Boxcars = Rp5.794.997,625/day

3.6 Recapitulation Operational Cost of Vehicles (trucks)

TABLE VI. OPERATIONAL COST OF VEHICLES

Alternative Location	*Distance km*	*Cycle time*	*Truck units*	*Operational cost*		*Cost/ km/units*
				Units/day	*Total*	
1	7.24	1.57	17	560.058	9.520.98	77.356
2	4.19	1.41	15	506.193	7.592.89	120.810
3	3.33	1.38	15	386.333	5.794.99	116.016

Advantages and Disadvantages of Location

Three different alternatives can be options for the authority of PPU Regency to build the warehouse. Certainly advisable to consider the existing and non-existent supporting infrastructure issues related to the available funding sources. In the course of future development, a location that can be extended to an area free from settlements is preferred because the consideration of expansion will be better, and land prices would be lower. Buluminung Industrial Area that is placed between the port and the central business district. This area is designated by the government as an industrial area supporting the PPU economy. The determination of the Buluminung Industrial Estate by Bapelitbang and stipulated in the RPJMD and Perda No.1 of 2019 is appropriate because of it is strategic position and has the potential for local raw materials supported by adequate facilities and infrastructure.

However, the facilities to become an integrated industrial area are still very limited.

TABLE VII. ADVANTAGES AND DISADVANTAGES OF LOCATION

Description	***Location 1***		***Location 2***		***Location 3***	
	Adv.	***Disadv.***	***Adv.***	***Disadv.***	***Adv.***	***Disadv.***
Land area	Large		Middle			Small
Position	Riversid (can build a pier & cool storage)	Part of the land is swamp	Flat land & easy to reach	Far from river/sea	Flat land & easy to reach	Far from river/sea
BOK		Expensive		Quite expensive	Cheap	
Land carrying capacity		Low/weak		Quite weak	Wide enough	
Construction cost		Expensive	cheap		cheap	
Loading distance		Far	close		closer	

IV. RESULTS

Economically, the development of the Warehousing Area will be able to provide benefits for the government, the community, and business actors, including reducing the risk of damage to goods, reducing operational costs, transport time, efficiency, reducing road pressure/load, and providing substantial input for regional income.

In order to carry out a feasible development of the warehousing area based on the B/C analysis, the NPV Negative and NPV Positive need to be around B/C=1,07. Each expenditure of Rp.1.00 will provide benefits of 1.07 times.

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