

Optimization of Warehouse Selection with SWOT and AHP Methods in the Pulogadung Industrial Area

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ABSTRAK

Penelitian ini bertujuan untuk menganalisis faktor-faktor yang mempengaruhi penentuan lokasi dan ruang gudang di Kawasan Industri Pulogadung, Jakarta, dengan menggunakan analisis gabungan SWOT (Strengths, Weaknesses, Opportunities, Threats) dan AHP (Analytical Hierarchy Process). Metode penelitian yang diterapkan adalah kualitatif. Partisipan dalam penelitian ini adalah pimpinan perusahaan yang beroperasi di Kawasan Industri Pulogadung. Data dikumpulkan melalui penggunaan angket SWOT dan angket AHP yang diberikan kepada responden. Data SWOT dianalisis menggunakan perangkat lunak Excel, sementara data AHP dianalisis dengan menggunakan perangkat lunak Super Decision. Hasil penelitian mengungkapkan bahwa faktor-faktor yang memengaruhi penentuan lokasi dan ruang gudang di Kawasan Industri Pulogadung meliputi kedekatan dengan jalan utama, lokasi gudang yang terpusat, kedekatan dengan terminal distribusi barang, kedekatan dengan pelabuhan, dan efisiensi biaya perawatan gudang. Analisis SWOT dan AHP menunjukkan tingkat kepentingan determinan lokasi Kawasan Industri Pulogadung, Jakarta. Faktor "kekuatan" paling penting adalah lokasi gudang dekat dengan jalan utama, sementara faktor "kelemahan" yang perlu dihindari adalah tingginya biaya sewa gudang. Faktor "peluang" yang harus dimanfaatkan adalah penerapan teknologi modern, dan faktor "ancaman" yang perlu dihindari adalah munculnya biaya perawatan gudang yang lebih efisien di gudang pesaing. Penelitian ini memberikan wawasan penting bagi perusahaan yang beroperasi di Kawasan Industri Pulogadung dalam menentukan lokasi gudang mereka.

ABSTRACT

This study aims to analyze the factors that influence the determination of location and warehouse space in Pulogadung Industrial Estate, Jakarta, using a combined SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) and AHP (Analytical Hierarchy Process). The research method applied is qualitative. Participants in this study were leaders of companies operating in the Pulogadung Industrial Estate. Data was collected through the use of SWOT questionnaires and AHP questionnaires given to respondents. SWOT data is analyzed using Excel software, while AHP data is analyzed using Super Decision software. The results revealed that factors that affect the determination of warehouse location and space in the Pulogadung Industrial Estate include proximity to the main road, centralized warehouse location, proximity to the goods distribution terminal, proximity to the port, and efficiency of warehouse maintenance costs. SWOT and AHP analysis show the importance of the determinants of the location of the Pulogadung Industrial Estate, Jakarta. The most important "strength" factor is the location of the warehouse close to the main road, while the "weakness" factor that needs to be avoided is the high cost of renting the warehouse. The "opportunity" factor that must be exploited is the application of modern technology, and the "threat" factor that needs to be avoided is the emergence of more efficient warehouse maintenance costs in competitors' warehouses. This research provides important insights for companies operating in the Pulogadung Industrial Estate in determining the location of their warehouses.

1. INTRODUCTION

Warehouse management is an important part of supply chain management because warehouses can determine efficient logistics operations, and these logistics operations play a key role in maintaining a company's competitive advantage (Shah & Khanzode, 2017; Van Geest et al., 2021; Zhen & Li, 2022). The

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purpose of a warehouse as stated by previous research is to satisfy customers by effectively utilizing resources and sending the right product, in the right place, at the right time, and in good condition (Laosirihongthong et al., 2018; Staudt et al., 2015; Toral et al., 2023). Along with industrial development, warehouses also experienced many developments. Among them, the term "modern warehouse" is now known to distinguish it from traditional warehouses (Kumar et al., 2021; Tejesh & Neeraja, 2018). However, according to previous research, all stakeholders related to warehousing should return to the basics, namely that the existence of warehouses is to achieve efficiency and effectiveness in the supply chain, as well as provide a number of perspectives on current and future challenges (Cerchione & Esposito, 2016; Rajaguru & Matanda, 2019; Tavčar et al., 2018). It is important to note that the optimal way to select warehouses is to pay attention to the flow of materials and typical warehouse operations (Accorsi et al., 2014; Kembro et al., 2018). Material flow in most warehouses includes receiving, picking, storage, and shipping. Whereas typical warehouse operations can be expanded to include receiving, putting away, internal replenishment, order picking, accumulating and sorting, packing, cross-docking, and shipping. One of the efforts and, at the same time, a factor that also determines the efficiency and effectiveness of a warehouse is the location of the warehouse. Spatial analysis is location analysis that focuses on the three elements of distance, interaction, and movement. The purpose of spatial analysis is to measure whether the existing conditions are in accordance with the spatial structure and analyze interactions between spatial units, namely the relationship between the economy and spatial interactions, accessibility between the center and stops of an area, and interaction barriers. This is based on the existence of places (cities) that are the centers of activity for other places, as well as the existence of a hierarchy between these places.

The selection of warehouses can be analyzed based on a combined analysis of strengths, weaknesses, opportunities, and threats (SWOT) and the analytical hierarchy process (AHP) to determine the factors that influence the determination of warehouse locations. There are a number of previous studies that have used SWOT and AHP analysis to determine the factors that influence the determination of a choice. Previous research used a combination of AHP and SWOT to determine the choice of factors and sub-factors in e-Government projects in Turkey (de FSM Russo & Camanho, 2015; Gupta et al., 2017). Similar research designed a combined AHP and SWOT analysis research framework for determining factors and sub-factors in manufacturing companies (Jain et al., 2022; Sharma & Beg, 2020). Previous research uses AHP-SWOT analysis for strategic planning for non-profit institutions, namely the Indonesian Ecolabelling Institute (LEI) (Mukhlisin & Pasaribu, 2020; Surveyandini, 2022). Previous research uses a combined AHP and SWOT analysis to select factors that need to be prioritized in tourism strategic planning in Varazdin, a small town in Central Europe (Kiši, 2019; Nikolić et al., 2015). Similar research used a combined SWOT-AHP analysis to determine priority options for HR development strategies for the ESDM sector at the ESDM Training Agency (Ati et al., 2019; Wicaksono et al., 2017). Previous research used a combined SWOT and AHP analysis in designing the strategy of Payame Noor University (PNU), South Korea, under the conditions of an ever-evolving industrial environment (Yulmaini et al., 2018; Yusof & Salleh, 2013). Previous research used the SWOT-AHP model in determining the choice of alternative D3 vocational college development strategies (Lenis Escobar et al., 2020; Morovati & Akbarian, 2020). In determining marketing strategy priorities in the real estate industry, previous research employs a SWOT-AHP combination analysis (Jain et al., 2022; Sharma & Beg, 2020).

Research on warehouse selection strategies can use the SWOT-AHP combination model because SWOT and AHP complement each other in obtaining the right strategy when selecting warehouses. Errors in warehouse selection will result in high costs and/or costs in the supply chain. Costs will be higher and/or time will be longer if the location of the warehouse is far from main roads, terminals, or places of distribution of goods; industrial agglomeration (concentration) areas; trading activities; integrated terminals, ports, and so on; production and marketing. Choosing the wrong warehouse can also slow down the supply of raw materials, the production process, and the delivery process in marketing. not to mention the risks in terms of security and others. All of that will ultimately have an impact on the company's overall performance. Starting from the background above, it is important to know the factors that influence the determination of warehouse location and space by stakeholders in the Pulogadung Industrial Area, Jakarta, using a combined SWOT and AHP analysis. The formulation of this problem is detailed in this research question, namely the first, what are the factors that influence the determination of the location and space of the warehouse in the Pulogadung Industrial Area, Jakarta, using SWOT and AHP analysis, and the second, what is the level of importance of the determining factors for the location of the Industrial Area Pulogadung, Jakarta, using SWOT and AHP analysis.

2. METHODS

The subject of this study is a warehouse, in this case one in DKI Jakarta Province's Pulogadung industrial area. This research method is quantitative because it seeks to measure something precisely (Cooper, D. R. & Schindler, 2014). Among the choices of experimental or survey research designs, this research design is a survey research design, namely, a research design in the form of a quantitative description of trends, attitudes, and opinions of a population or a test for associations between variables of a population by studying a sample of the population. Data analysis techniques using a combination of SWOT and AHP methods. The SWOT and AHP analysis stages use the model from previous research, as follows, when entering the AHP analysis stage using the Super Decisions software: (1) Identify the factors in each SWOT group (factors for strengths, factors for weaknesses, factors for opportunities, and factors for threats); (2) All factors in the four SWOT groups are rated by each source (e.g., resource persons A, B, C, D, and so on); (3) The values of each factor originating from the sources are then added up, and the average value is calculated; (4) Based on the average score, three factors with the highest average score are selected for each SWOT group. It means that for strengths, three factors are selected with the highest average value; for weaknesses, three factors are selected with the highest average value; for opportunities, three factors are selected with the highest average value; and for threats, three factors are also selected with the highest average value; (5) After selecting the factors for each SWOT group (strengths, weaknesses, opportunities, and threats), start the AHP analysis process by building a pairwise comparison matrix in each hierarchy that, besides having a relationship with the level above it, uses a scale of 1–9 (details of the SWOT-AHP process are presented in Chapter II, sub-chapter 2.1.6); (6) Calculating the eigenvector value, namely by adding up each column; (7) Calculate the consistency index (CI) and the value of the consistency ratio (CR) to assess the consistency of research results; (8) Make a sensitivity analysis to observe the behavior of the subfactors by changing the weights of the main factors; (9) Determine alternative strategies for selecting warehouses, supported by the results of the literature analysis; (10) Make a sensitivity analysis to observe the behavior of alternative strategies by changing the main factor weights. supported by the results of the literature analysis.

3. RESULTS AND DISCUSSIONS

Results

Warehousing in the Pulogadung Industrial Area

Currently, Indonesia has 74 industrial areas, 67 of which are concentrated on the island of Java. One area that is of great interest to investors is the Pulogadung Industrial Area, which is located in East Jakarta City, DKI Jakarta Province. This industrial area is the first industrial area in Indonesia. Originally, Pulogadung was an unproductive area, most of which was swamp. Through the Decree of the Governor of DKI Jakarta No. 1b.3.2.2.35/1969, in this area it was determined that a land area of 500 hectares was the location of an industrial area. Then, after going through infrastructure development efforts, the Pulogadung Industrial Zone was established on June 26, 1973, under the name PT Jakarta Industrial Estate Pulogadung (JIEP). The composition of JIEP shareholders is 50 percent of the Republic of Indonesia and 50 percent of the Provincial Government of DKI Jakarta.

Until now, 98 percent of the area has been fully occupied by enthusiasts, who now number a total of 400 companies. The area covers about 500 hectares, 11 hectares of which are land for industrial areas. According to the Director of Operations and Development of PT Jakarta Industrial Estate Pulogadung (JIEP), Bilson Manalu revealed that most (70%) of the area users are domestic companies, and the rest (30%) are foreign companies (Khoer, 2017). The industrial sectors in the industrial estate include the pharmaceutical sector, printing, musical instruments, steel, semi-finished goods, and warehouses for public companies. The Pulogadung Industrial Area, East Jakarta, has many warehouse buildings, ranging from small warehouses to large service-scale warehouses to even a warehouse complex. where the use of the warehouse is very varied, for example, to store raw materials or as a logistics warehouse. The Pulogadung Industrial Estate now has financial center facilities, ready-to-use factory buildings, logistics warehouses, industrial plots of land, logistics warehouses, and warehousing, as well as offices and SMEs. This area also pays attention to environmental issues, including the preparation of green areas. Today, JIEP has the motto "JIEP Ecogreen Industrial Estate." The closest facilities and infrastructure from JIEP are: (i) The nearest airport is Halim Perdanakusumah, which is 9.5 km away via the Jakarta Inner Ring Road (Jl. Pulomas-Cawang), Jl. Cililitan 2 Toll Road (Jl. Ir Wiyoto Wiyono Toll Road), and Soekarno Hatta Airport, which is 3 km away. (ii) The nearest ports are Tanjung Priok and New Priok Ports, which are 16 kilometers away. (iii) The nearest station is Cibitung Station and Gambir Station, which are both 7 km away; (iv) The nearest terminal is Pulogadung Terminal, which is 1 km away; and (v) the nearest toll exit is the Cakung Exit (JORR Toll Road) and the Rawamangun Toll Road, with a distance of 4 km.

Discussion

Factors Influencing Warehouse Selection

Based on the research results, it can be seen that The factors that influence the determination of the location and space of the warehouse in the Pulogadung Industrial Area, based on a combined SWOT and AHP analysis, are: (a) Based on the strength factor, which means the characteristics that can provide an advantage for users compared to competitors in an industry, the informant considered the following factors that must be owned: the location of the warehouse close to the main road; centralized or gathered warehouses in one area; and warehouses close to terminals or places of distribution of goods. The AHP processing results for the strength factor show a yield of 63.44% for locations near main roads, followed by 26.83% for centralized locations, and finally 11.72% for locations near terminals; (b) Based on the weakness factor, which means unfavorable characteristics in comparison to competitors, the informant identified the following risks that must be avoided or minimized: already high land prices; high warehouse rental costs; and traditional security systems. The AHP-processed results for the weakness factor showed a yield of 65.66% for high rental costs, followed by 26.05% for traditional security systems, and finally 8.27% for expensive land prices; (c) Based on the opportunity factor, which means external elements in the environment that can provide benefits to the organization, the informants considered the following factors that must be utilized or realized, namely: modern technology for warehousing management; the need (demand) for warehousing continues to increase; and cooperation with external parties. The AHP processed results for the opportunity factor show a yield of 65.19% for the application of modern technology, followed by 23.50% for increased warehouse needs, and finally 11.30% for opportunities for cooperation with foreign countries; (d) Based on threats, which are external elements in the environment that can cause problems for an organization, the informant identified the following factors as risks that must be avoided or minimized: the emergence of new warehouses with more modern facilities and technology; new warehouse locations that are more strategically located, such as closer to the port; and other relatively more efficient warehouse maintenance costs. The AHP processing results for threat factors show 64.33% results for other more efficient warehouse maintenance costs, followed by 25.33% for new warehouses with more strategic locations, and finally 10.13% for new warehouses with modern facilities.

What is the level of importance of the determining factors for the location of the Pulogadung Industrial Estate, Jakarta? Using SWOT and AHP analysis, there are four subfactors that must be considered, which are the four subfactors that have the highest level of importance in each SWOT factor (strengths, weaknesses, opportunities, and threats) (Abdel-Basset et al., 2018; Kurt, 2020; Tahernejad et al., 2013). The subfactor with the highest importance on the "strength" factor, which means it should be maintained and increased, is the location of the warehouse near the main road (Kang, 2020; Rahmadani, 2020). The subfactor with the highest importance on the "weakness" factor, which means it should be avoided, is the high rental cost of the warehouse (Lim et al., 2018; Septiandre & Siswanto, 2016). The subfactor with the highest importance is the "opportunity" factor, which means it is a sub-factor that must be taken or utilized as optimally as possible, namely the application of modern technology (Singh & Nachtnebel, 2016; Wang et al., 2017). The subfactor with the highest importance is the "threat" factor, which means it must be avoided or minimized, namely the threat of the emergence of more efficient warehouse maintenance costs in competitors' warehouses (Goksoy et al., 2013; Richards, 2017).

The implication of these findings is that warehouse siting requires a deep understanding of the strengths, weaknesses, opportunities, and threats that can affect the success of the warehouse. Therefore, stakeholders must consider these factors in making decisions regarding warehouse location. However, keep in mind that each factor has a different level of importance, and priority should be given to those factors that have the highest level of importance. A limitation of this study is that SWOT and AHP analyses only provide a view of the factors that must be considered in determining warehouse location. Further analysis and more comprehensive data are needed to make more accurate decisions. Therefore, the recommendation based on these limitations is to conduct further studies that involve a more in-depth analysis of the factors affecting the location of the warehouse. This will help ensure more informed and effective decisions in determining warehouse locations in the context of logistics planning.

4. CONCLUSION

Based on the results of these studies, it can be concluded that: (1) The determining factor in selecting a warehouse based on the SWOT analysis is the location of the warehouse: close to the main road; centralized or gathered warehouses in one area; and warehouses close to terminals or places where goods are distributed. The informant considered the following risks to be avoided or minimized: land prices, which are already high; warehouse rental costs, which are also quite high; and security

systems, which are still traditional. The informant considered the following factors that must be utilized or realized, namely: modern technology for warehousing management; the need (demand) for warehousing continues to increase; and cooperation with external parties. The informant considered the following factors that must be avoided or minimized, namely: the emergence of new warehouses with more modern facilities and technology; new warehouse locations that are more strategically located, such as closer to the port; and other relatively more efficient warehouse maintenance costs; (2) What is the level of importance of the determining factors for the location of the Pulogadung Industrial Estate, Jakarta, using SWOT and AHP analysis? The subfactor with the highest importance in the "strength" factor, which means that it must be maintained and improved, is the location of the warehouse near the main road. The subfactor with the highest importance on the "weakness" factor, which means it should be avoided, is the high rental cost of the warehouse. The sub-factor with the highest importance is the "opportunity" factor, which means it is a sub-factor that must be taken or utilized as optimally as possible, namely the application of modern technology. The subfactor with the highest importance is the "threat" factor, which means it must be avoided or minimized, namely the threat of the emergence of more efficient warehouse maintenance costs in competitors' warehouses.

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