Feasibility Study of Determination a New Distribution Warehouse Location Using P-Median and Analytical Network Process Methods in One of the Cement Industries

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Abstract. This research was carried out at one of the companies engaged in the cement industry, which distributed its products throughout Indonesia. However, based on audit results for the Central Java region, there are still a number of minor and major statuses in warehouse management perspectives and the percentage of warehousing cost components to the total distribution costs that exceed the maximum limit set at the warehouses rented from the distributor. Therefore, it’s necessary to determine a new distribution warehouse location owned by the company by considering qualitative and quantitative aspects, then stop the operation of a rented warehouse from a distributor because of the high subsidy costs. The method used in this research is investment feasibility analysis using Net Present Value and Benefit Cost Ratio calculations, determining optimal locations using the P-Median method, and determining location based on multi-criteria using the Analytical Network Process method. The results showed that the location with the highest weight based on multi-criteria decision making and declared feasible based on investment feasibility analysis was located in Cilacap Regency with the optimal location in North Cilacap District. If this decision is carried out, the company can reduce the total distribution costs that must be incurred by the company.

1. Introduction
Along with the development of the times, human needs today are constantly increasing and experiencing significant changes and it is a reason to support the emergence of industries that can meet human needs. Therefore, increasingly intense competition in the industry requires companies to have a strategy to win the market compared to competitors. By having sustainable strategic competitiveness, the company will have a competitive advantage because it is able to create value for its buyers\textsuperscript{[1]}.

One key to the success of a company to be able to win market competition lies in good supply chain management. Supply Chain Management includes the planning of all activities\textsuperscript{[2]}. The purpose of the Supply Chain is to satisfy customer needs and increase company profits\textsuperscript{[3]}. So, to achieve that success, one of the things that need to be considered in the supply chain is the product distribution process, where one of the costs incurred in the product distribution process is warehousing costs. Warehousing costs usually dominate about 20-30\% of the total distribution costs\textsuperscript{[4]}.

A good distribution process is a process that can run efficiently and effectively so that the volume of production, warehouse capacity and product allocation in each region in the distribution area reaches a good level of balance. In distribution planning, it is necessary to consider the distribution location that is considered the most potential and related to the area that is the area of distribution\textsuperscript{[3]}.
This research was carried out at one of the companies engaged in the cement industry, which distributed its products throughout Indonesia. However, based on audit result for Central Java region, there are still a number of minor and major statuses in warehouse management perspectives at the rented warehouse from the distributor, so that need to be improved. Then, the percentage of warehousing cost components at the rented warehouses from distributors on the total distribution costs exceeds the maximum limit set, at 37% while the maximum limit set by the company is 25-30%. One improvement step that can be done is determining a new distribution warehouse location owned by the company by considering qualitative and quantitative aspects, then stop the operation of the rented warehouse from a distributor because of the high subsidy costs.

The method used in this research is investment feasibility analysis using Net Present Value and Benefit Cost Ratio calculations, determining optimal locations using the P-Median method, and determining location based on multi-criteria decision making using Analytical Network Process methods. Therefore, by conducting this research, which is determining the right location for a new warehouse and stop the operation in one of the rented warehouses from the distributor is expected to reduce distribution costs, reduce warehousing costs, and increase company competitiveness.

2. Basic Theory

2.1. Warehouse Location

In a logistical flow, of course, there are many activities that support the logistics mission, there are the right place, the right goods, and the right time. Activities that play a role are related to one another and cannot be separated. The warehouse is one of the important elements that support logistics activities. The warehouse is usually used to store product inventor. For companies, this is useful for storing products that have not yet reached the hands of consumers. As for consumers, the warehouse serves to speed up the arrival of the product in their hands[5]. Then, in determining the location of a warehouse, a company should consider several things, including transportation costs, demand, product distribution networks, infrastructure, expansion, supporting facilities, geographical location, and climate[5].

2.2. P-Median

In the P-Median problem, there are divisions of several nodes, which within each node have the same opportunity to become a median or center the cluster. The main goal in solving problems with the P-Median is to place the P (median) facility closest to a group of consumers (nodes) around it so that it has the shortest distance between its facilities. In the settlement using P-Median, at least one optimal solution has to be placed into the network[5]. The mathematical model of the P-Median method is as follows[6].

\[
\text{Minimize: } \sum_i \sum_j h_i d_{ij}
\]

Description:

\[h_i = \text{Request at node } - i\]

\[d_{ij} = \text{Distance between the request point of node } i \text{ and node } j, \text{ i.e. the candidate built}. \text{ } d_{ij} \text{ is zero if } i = j\]

2.3. Feasibility Study

The feasibility of investment or business is a study of whether a business or investment can be carried out successfully. The main objective is to avoid the risk of loss that will be suffered by the company if the business plan is failed or does not meet expectations[7]. In the feasibility study, there are several aspects that must be considered, namely legal aspects, market and marketing aspects, financial or financial aspects, technical or operational aspects, management or organizational aspects, economic and social aspects, and environmental impact aspects[7]. Like a business that has been planned if viewed through financial aspects or financial aspects can be known through the calculation of Net Present Value (NPV) and Benefit Cost Ratio (BCR)[8].
2.3.1. Net Present Value. Net Present Value (NPV) is the calculation of the difference between benefits (revenues) and costs (expenses) that have been estimated benefits or benefits from the planned project. Thus, NPV calculations rely on discounted cash flow techniques. The NPV calculation formula is as follows[8].

\[ \text{NPV} = \text{PV Benefit} - \text{PV Cost} \]

NPV Assessment Criteria:
If NPV > 0, the investment proposal is feasible to proceed
If NPV < 0, the investment proposal is not feasible to proceed
If NPV = 0, investment only experiences Break Event Point, which is only to cover production costs

2.3.2. Benefit Cost Ratio. Benefit Cost Ratio (BCR) is a comparison between the present value of net benefits and the present value of net costs. The BCR calculation formula is as follows[8].

\[ \text{BCR} = \frac{\text{present value cash inflow}}{\text{present value initial investment}} \]

BCR Assessment Criteria:
B/C Ratio ≥ 1 = Decent
B/C Ratio ≤ 1 = Ineligible

2.4. Analytical Network Process
Analytical Network Process (ANP) is a method that is able to represent the level of importance of various parties by considering the relationship of dependency, both between criteria and between sub-criteria that are points for measuring several predetermined criteria. Analytical Network Process can produce a more accurate approach because the ANP method is able to handle complex problems, which are closely related to dependency and feedback[9].

This ANP method is a development of the Analytical Hierarchy Process (AHP) method, in which the ANP method can correct the deficiencies found in the previous method[9]. There are some differences between ANP and AHP, mainly the AHP there is no relationship between sub-criteria, while in ANP there is a relationship, which is usually called the inner dependences and outer dependences. Inner dependence is a relationship between elements in the same cluster, so this cluster will connect with itself so that it will form a loop relationship, while outer dependence is a relationship between elements in a different cluster, so that one cluster will be connected to one another cluster[10]. AHP describes complex multi-criteria issues into a hierarchy while ANP describes it into a network[11].

There are four main procedures in completing using the Analytical Network Process method, there are developing a construct a decision model, making a pairwise comparison matrix of interrelated variables based on a 1-9 ratio scale, processing and forming the Super Matrix, and determining the best alternative[12].

2.4.1. Construct a Decision Model. Model construction is based on existing problems, so it is necessary to clearly describe the problem, and form it into the network. In describing the problem, there are two steps that must be done, namely the determination of alternatives used as research objects and determination of criteria and subcriteria[12]. Then, in order to construct a decision network model, it is necessary to identify the dependency relationships between criteria and sub-criteria or better known as inner and outer dependencies[10].

The alternative determination that will be used as the object of research can be done by calculating pairwise comparison, rating calculation, and weighted value calculation[6]. Calculations using this method are suitable if there are many alternatives and only a few alternatives that will be chosen. In
addition, to be able to do calculations with this method, so certain criteria are needed to choose several alternatives that have the highest priority. The weighted value calculation formula is as follows[6].

\[ yn = a.RAn + b.RBn + c.RCn \]  

(4)

Description:
\( yn \) = Weighted value of the alternative-\( n \)
\( a \) = Priority vector of criteria A
\( b \) = Priority vector of criterion B
\( c \) = Priority vector of C criteria
\( RAn \) = Rating criterion A on alternative-\( n \)
\( RBn \) = Rating criterion B on alternative-\( n \)
\( RCn \) = Rating criterion C on alternative-\( n \)

Then, this following is a calculation of the rating value for criterion X in alternative-\( n \) (\( RXn \)):

\[ RXn = \frac{RXn}{Total RX} \times 100 \]  

(5)

Description:
\( n \) = Alternative-\( n \)
\( RX \) = Criteria X
\( RXn \) = Rating value of criterion X in alternative-\( n \)

Other than that, to identify the inner and outer dependencies, it can be done by filling out the questionnaire by experts. This questionnaire aims to determine the relationship of dependence between criteria and sub-criteria as a basic reference to construct the ANP models[10]. To state that the criteria and sub-criteria have a dependence, it is necessary to look at the number of experts who provide an assessment of the dependency between the criteria and sub-criteria with the following formula[10].

\[ Q = \frac{N}{2} \]  

(6)

Description:
\( N \) = Number of experts who provide an assessment of the dependency
If \( N \geq Q \), so, there is a relationship between the criteria and sub-criteria.

2.4.2. Making a Pairwise Comparison Matrix. Pairwise comparisons on ANP method are performed by comparing the importance of each element to its control criteria. The scale used for comparison is the numerical scales 1-9[12]. The following is a further explanation of the numerical scale on ANP.

| Scale | Definition          | Annotation                                      |
|-------|---------------------|------------------------------------------------|
| 1     | Equally Important   | Two elements are equally important to alternatives |
| 3     | A Little More       | One element is slightly more important than the other elements |
|       | Important           |                                                 |
| 5     | More Important      | One element is more important than the other elements |
| 7     | Far More Important  | One element is far more important than the other elements |

Table 1. The Numerical Scale on ANP Method
Absolute More Important

| 2, 4, 6, 8 | Middle Value | Values between two value considerations are close together |

To get a pairwise comparison matrix assessment, it can be done by filling out the questionnaire by experts. This questionnaire was made based on the dependency relationship obtained from the previous questionnaire[10]. If the number of respondents is more than one person, a Geometric Mean (GM) calculation is performed. The formula is:

$$GM = (R_1 \times R_2 \times \ldots \times R_n)^{1/n}$$

(7)

Description:
G = Geometric Mean
n = Number of Respondents
R = Respondent Questionnaire Value

Then, if the pairwise comparisons have been made entirely, the next is to calculate the priority vector w (called the eigenvector). The eigenvector is the priority weight of the matrix which is then used in the preparation of the supermatrix calculated by the formula[10]:

$$A \times w = \lambda_{max} \times w$$

(8)

Description:
A = Pairwise Comparison Matrix
$\lambda_{max}$ = Eigen Value

Then, check the inconsistency ratio. Consistency ratio is the ratio that states whether the judgments given by experts are consistent or not. Inconsistency ratios less than 0.1 or 10% have reliable and consistent results[13]. The consistency index (CI) of a comparison matrix is calculated by the formula:

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

(9)

The consistency ratio is obtained by comparing the consistency index with the values of the random consistency index (RI) numbers, as follows:

$$CR = \frac{CI}{RI}$$

(10)

Description:
$\lambda_{max}$ = The largest eigenvalue of the pairwise comparison matrix $n \times n$
n = Number of Items Compared
CI = Consistency Index
RI = Random Consistency Index

The mathematical model used to find the Ratio Index (RI) is as follows:

$$RI = \frac{1.98(n - 2)}{n}$$

(11)

2.4.3. Construct The Super Matrix. Super matrix is a matrix consisting of sub-matrices that are composed of a set of relationships between the two levels contained in the model. There are three supermatrix stages in the ANP model, namely the Unweighted Super Matrix, Weighted Super Matrix, and Limit Matrix[12].
2.4.4. Determination of the Best Alternative. After obtaining the value of each element in the limit matrix, next is to choose the best alternative. The alternative with the highest global priority is the best alternative.

3. Research Method
The initial stages carried out in this research are identifying market potential criteria and doing some calculations to obtain five regencies or cities in the Central Java region which will be used as the focus of research. The next stage is the identification of criteria and sub-criteria. After that, a calculation is made to get the optimal sub-districts of each selected district and city using the P-Median Method. Next, an investment feasibility study was conducted on five alternative locations using NPV and BCR calculations. The final stage is data processing using the ANP method and decision making is made to determine the best and optimal location.
Three criteria are used to determine alternatives based on the market potential set by the company, including the number of retailers, the number of construction service companies, and the number of development projects. The number of alternatives selected as alternative locations is five regencies or cities. The steps taken to determine alternatives are the calculation of pairwise comparison, calculation of the rating value, and calculation of the weighted value. The results are shown in Table 2.

Table 2. Weighted Values for each District and City
Based on the result of the weighted value that is shown in Table 2, it is known that five regencies/cities that are selected for the alternative, namely Banyumas Regency, Brebes Regency, Semarang City, Cilacap Regency, and Klaten Regency. After determining the selected alternative next determine the optimal sub-district of each selected district and city by using the $P$-Median Method and the criteria considered are the smallest demand-weighted distance. The results are shown in Table 3.

### Table 3. Optimal Sub-District for each Regency or City

| No | District/City       | RR   | a     | RK   | b     | RP   | c     | Weighted Value |
|----|---------------------|------|-------|------|-------|------|-------|----------------|
| 1  | Banjarnegara        | 2.86463209 | 0.7   | 3.026998 | 0.2   | 2.935151 | 0.1   | 2.908368852   |
| 2  | Banyumas            | 5.97266643 | 0.7   | 3.745114 | 0.2   | 2.963959 | 0.1   | 5.10016593    |
| 3  | Batang              | 2.13443175 | 0.7   | 1.945278 | 0.2   | 3.300045 | 0.1   | 2.250027915   |
| 4  | Blora               | 2.63995506 | 0.7   | 3.526952 | 0.2   | 2.355803 | 0.1   | 2.789538047   |
| 5  | Boyolali            | 2.82718592 | 0.7   | 1.681665 | 0.2   | 2.978362 | 0.1   | 2.605201879   |
| 6  | Brebes              | 3.98801723 | 0.7   | 3.608763 | 0.2   | 1.726842 | 0.1   | 3.606026649   |
| 7  | Cilacap             | 5.09267927 | 0.7   | 6.226707 | 0.2   | 3.04878 | 0.1   | 5.059597563   |
| 8  | Demak               | 3.01441678 | 0.7   | 3.981456 | 0.2   | 3.067985 | 0.1   | 3.225998851   |
| 9  | Grobogan            | 3.16420146 | 0.7   | 2.663394 | 0.2   | 3.090391 | 0.1   | 3.04847931    |
| 10 | Jepara              | 3.12675529 | 0.7   | 2.627034 | 0.2   | 2.931951 | 0.1   | 2.995112261   |
| 11 | Karanganyar         | 2.84590901 | 0.7   | 1.472593 | 0.2   | 3.063184 | 0.1   | 2.584591859   |
| 12 | Kebumen             | 3.74461711 | 0.7   | 2.917917 | 0.2   | 2.984764 | 0.1   | 3.468429471   |
| 13 | Kendal              | 2.86463209 | 0.7   | 1.908917 | 0.2   | 3.027975 | 0.1   | 2.684396922   |
| 14 | Klaten              | 3.66972477 | 0.7   | 3.126998 | 0.2   | 3.196018 | 0.1   | 3.491761236   |
| 15 | Kudus               | 3.05186295 | 0.7   | 2.599764 | 0.2   | 3.208821 | 0.1   | 2.977239738   |
| 16 | Magelang            | 3.25781689 | 0.7   | 1.07263 | 0.2   | 3.058383 | 0.1   | 2.76924899     |
| 17 | Magelang City       | 0.67403108 | 0.7   | 1.563494 | 0.2   | 1.99251 | 0.1   | 1.03805079    |
| 18 | Pati                | 4.17524808 | 0.7   | 2.23616 | 0.2   | 2.826324 | 0.1   | 3.585274238   |
| 19 | Pekalongan          | 1.92847781 | 0.7   | 2.21798 | 0.2   | 3.189617 | 0.1   | 2.158012344   |
| 20 | Pekalongan City     | 1.44167759 | 0.7   | 0.963549 | 0.2   | 2.011715 | 0.1   | 1.416688538   |
| 21 | Pemalang            | 3.29526306 | 0.7   | 3.126998 | 0.2   | 3.114397 | 0.1   | 3.235548321   |
| 22 | Purbalingga         | 2.95824752 | 0.7   | 1.872557 | 0.2   | 3.035977 | 0.1   | 2.73910804    |
| 23 | Purworejo           | 2.52761655 | 0.7   | 1.799836 | 0.2   | 2.856731 | 0.1   | 2.417693494   |
| 24 | Rembang             | 2.17187793 | 0.7   | 3.572403 | 0.2   | 2.952756 | 0.1   | 2.572178163   |
| 25 | Salatiga City       | 0.86126194 | 0.7   | 1.06354 | 0.2   | 1.803662 | 0.1   | 1.029812688   |
| 26 | Semarang            | 1.92847781 | 0.7   | 2.072539 | 0.2   | 3.019973 | 0.1   | 2.104622486   |
| 27 | Semarang City       | 4.88672533 | 0.7   | 10.8172 | 0.2   | 2.643877 | 0.1   | 5.841055525   |
| 28 | Sragen              | 2.65867815 | 0.7   | 3.072448 | 0.2   | 3.140004 | 0.1   | 2.810395183   |
| 29 | Sukoharjo           | 3.18292455 | 0.7   | 3.417871 | 0.2   | 3.096793 | 0.1   | 3.221095516   |
| 30 | Surakarta City      | 1.89103164 | 0.7   | 2.536133 | 0.2   | 3.064785 | 0.1   | 2.184075665   |
| 31 | Tegal               | 3.18292455 | 0.7   | 4.090537 | 0.2   | 3.301645 | 0.1   | 3.390640159   |
| 32 | Tegal City          | 0.91743119 | 0.7   | 1.308972 | 0.2   | 1.976506 | 0.1   | 1.141565585   |
| 33 | Temanggung          | 2.02209324 | 0.7   | 1.754386 | 0.2   | 3.176813 | 0.1   | 2.119629296   |
| 34 | Wonogiri            | 2.52761655 | 0.7   | 3.090628 | 0.2   | 2.831125 | 0.1   | 2.687148594   |
| 35 | Wonosobo            | 2.50883947 | 0.7   | 3.29061 | 0.2   | 3.026375 | 0.1   | 2.743220281   |
Next is an investment feasibility analysis of each alternative location that has been determined. This investment feasibility analysis will be processed by calculating the Net Present Value (NPV) and Benefit Cost Ratio (BCR) with the criteria considered are NPV > 0 and BCR > 1. Then, the results of the investment feasibility analysis calculation can be used as consideration for experts in providing an assessment of alternative locations based on consideration of several other aspects which will then be processed using the Analytical Network Process method. The results of calculations for investment feasibility analysis in each selected alternative are shown in Table 4.

**Table 4. Calculation Results for Investment Feasibility Study**

| Feasibility Study | Banyumas Regency | Klaten Regency | Semarang City | Cilacap Regency | Brebes Regency |
|-------------------|------------------|----------------|---------------|-----------------|---------------|
| NPV               | Rp256,544,937.556| Rp22,555,409.371| Rp6,526,325,297.905| Rp883,283,157.634| Rp99,000,175.861|
| BCR               | -1.565449376     | 1.225554904     | -5,453,252,979 | 9.832831576     | 0.009998241   |
| Note              | NPV < 0, BCR < 1 | NPV > 0, BCR > 1| NPV < 0, BCR < 1| NPV > 0, BCR > 1| NPV < 0, BCR < 1|
| Conclusion        | Not Feasible     | Feasible        | Not Feasible   | Feasible        | Not Feasible  |

After that, the criteria and sub-criteria will be determined to be used in data processing with the ANP method and identify the dependence between the criteria and sub-criteria which will then be input to construct the ANP network model. So, the criteria and sub-criteria that used in determining the location of the warehouse are:

**Table 5. List of Criteria and Sub-Criteria (a)**

| Criteria            | Sub-Criteria                                  | Source                               |
|---------------------|-----------------------------------------------|--------------------------------------|
| Legal               | Government Policy                            | Ashrafzadeh. et al. 2012             |
|                     | Legal Restrictions                           | Handayani. et al. 2010               |
|                     | Political Environment                        | Handayani. et al. 2010               |
|                     | Lead Time and Responsiveness                 | Ashrafzadeh. et al. 2012             |
| Market and Marketing| Retailer's reputation                        | Noviandri. et al. 2015               |
|                     | Marketing Scope                              | Handayani. et al. 2010               |
|                     | Water Infrastructure                         | Turgut. et al. 2011                  |
| Technical           | Quality and Reliability of Utilities         | Ashrafzadeh. et al. 2012             |
|                     | Energy and Electricity Infrastructure        | Turgut. et al. 2011                  |

**Table 6. List of Criteria and Sub-Criteria (b)**

| Criteria            | Sub-Criteria                                  | Source                               |
|---------------------|-----------------------------------------------|--------------------------------------|
| Economy and Social  | Level of Social Acceptance and Independent Security System | Gracia. et al. 2008                  |
|                     | Criminality                                   | Gracia. et al. 2008                  |
|                     | Proximity to Sources of Labor                 | Achsin. et al. 2011                  |
The identification of dependency between criteria and sub-criteria is done by filling out questionnaires by three experts. The results of the identification are as follows:

| AFFECTING | GP | LR | PE | LTR | RR | MS | WI | QRU | EEI | TPS | TK | KTK | IL | KIL | KLS |
|-----------|----|----|----|-----|----|----|----|-----|-----|-----|----|-----|----|-----|-----|
| GP        |    |    |    | 3   | 3  | 1  | 2  | 1   |     |     |    |     |    |     |     |
| LR        |    |    |    | 1   | 2  |    |    |     |     |     |    |     |    |     |     |
| PE        | 3  | 1  |    |     |    |    |    |     |     |     |    |     |    |     |     |
| LTR       |    |    |    |     | 1  |    |    |     |     |     |    |     |    |     |     |
| RR        |    |    |    |     |    |    |    |     |     |     |    |     |    |     |     |
| MS        | 3  | 2  | 3  | 1  |    | 3  | 1  |     |     |     |    |     |    |     |     |
| WI        | 1  |    |    |     |    |    |    |     |     |     |    |     |    |     |     |
| QRU       | 3  | 2  | 3  |     | 3  | 3  | 3  |     |     |     |    |     |    |     |     |
| EEI       | 2  | 3  | 3  |     | 3  | 3  | 3  |     |     |     |    |     |    |     |     |
| TPS       | 1  |    |    |     |    |    |    | 3   |     |     |    |     |    |     |     |
| TK        |    |    |    |     |    |    |    |     |     |     |    |     |    |     |     |
| KTK       | 3  | 3  | 3  | 1  |    |    |    |     |     |     |    |     |    |     |     |
| IL        |    |    |    |     |    |    |    |     |     |     |    |     |    |     |     |
| KIL       | 1  |    |    |     |    |    |    |     |     |     |    |     |    |     |     |
| KLS       | 3  | 3  | 3  | 3  | 3  |    |    |     |     |     |    |     |    |     |     |

*Figure 2. Result of Identification of dependencies between Criteria and Sub-Criteria*

Based on the results of the identification of dependencies between the criteria and sub-criteria that have been attached in Figure 2, it can be seen that there are several sub-criteria that have Outer Dependences and Inner Dependences. Inner Dependences can form a loop. After all, inputs have been completed, an ANP network model can be constructed as shown in Figure 3.

*Figure 3. ANP Network Model*

Based on data processing using the Analytical Network Process method, it can be seen that the alternative with the first priority sequence is Cilacap Regency. The weight of the value obtained by each alternative can be seen in Table 7.

*Table 7. Result of ANP*
Based on data processing that has been done, it can be concluded that the alternative is chosen as the location for the construction of a new distribution warehouse. namely Cilacap Regency because it is the first priority sequence based on processing by the ANP method and also Cilacap Regency is feasible based on the results of an investment feasibility study. Next, because the work on this data processing is parallel, then the optimal location for Cilacap Regency can be known based on calculations using the P-Median method that has been done previously. The optimal location for Cilacap Regency is located in the North Cilacap District with a demand-weighted distance of 11825073.8 and an average distance of all demand points of at least 32.305 km. Therefore, further analysis will be carried out on the construction of a new distribution warehouse owned by the company if it is carried out in the North Cilacap District.

The proposed improvement that can be done is to build a new distribution warehouse owned by a company located in North Cilacap Sub-District and stop the operation of the rented warehouse from the distributor located in Cilacap Regency because of the high cost of subsidies. With the proposed improvements, it can reduce the warehousing cost component rented from the distributor in the total distribution cost by 2% or decrease in cost components warehousing of Rp 3.243 for each ton of cement. Then, there was a decrease in total distribution costs of Rp 3.505 for each ton of cement. Thus, the total cost savings that can be achieved by the company is Rp 9,731,066.748.

5. Conclusion
Based on research that has been done. then there are several conclusions that can be drawn. the first is the steps taken to determine the location of the new distribution warehouse in this research are determining alternatives. determining the optimal location using the P-Median Method. analyzing the investment feasibility of each alternative using Net Present Value and Benefit Cost Ratio calculations. and multi-criteria decision making using Analytical Network Process Method. Second, the criteria to be considered at each stage are the number of retailers. the number of construction service companies. and the number of development projects for the alternative determination. the smallest demand-weighted distance for optimal location determination. NPV > 0 and BCR > 1 for investment feasibility analysis. and several other criteria. namely legal. market and marketing. technical. economic and social. and environmental impact to determine the location in multi-criteria decision making.

Based on data processing that has been done. it can be concluded that the alternatives were chosen as the location for the construction of a new distribution warehouse. namely Cilacap Regency because it is the first priority sequence with the highest weight and declared feasible. Next, because the work on this data processing is parallel. then the optimal location for Cilacap Regency is located in North Cilacap District. With the proposed improvements. it can decrease the cost components warehousing rented from the distributor of Rp 3,243 for each ton of cement. Then, there was a decrease in total distribution costs of Rp 3.505 for each ton of cement. Thus, the total cost savings that can be achieved by the company is Rp 9,731,066.748.

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