Industrial development zone with assignment method

L Nurwandi* and P Renosori
Departement of Industrial Engineering, Universitas Islam Bandung, Bandung, Indonesia

*luthfi69ti@gmail.com

Abstract. This study concern with finding new areas for potential industry that can be developed and characterizes the region. Five potential industries observe to be developed, namely fisheries, petrochemicals, food and beverages, handicrafts, and fashion, will be located in a zone, which has the potential to be the provincial capital of an island in Indonesia. The five potential industries will be assessed by five factors consisting of technology, transportation, social, policy, and economy. The phenomenon of determining which areas will be made, the area of industrial development by taking into account five sub-factors including the multi-criteria decision making (MCDM) where the decision to choose the developed industry depends on the assessment of stakeholder preferences, which consists of the government, the public, industrial actors, and investors with consider influential factors. In research the MCDM model used is the Analytic Hierarchy Process which will produce weights, then the weights are used as input to determine which industries are feasible to be developed using the assignment method. Research results show that food and beverage industry must be developed with focus on technology and economy pillars to enhance and support the community to keep the development and sustainability of region potential industry.

1. Introduction
An area will develop, if its capacity has declined in terms of economic [1], social [2], land capacity [3], and quality of life aspects [1]. In order to overcome this important phenomenon, the decision makers to look for new regions, which can be used as a centre of government, economy, and policy makers with the aim of providing flexibility to the region to have a capacity for economic performance, social, and a better quality of life [1,4].

This research will discuss efforts to determine the development of an area in order to become the centre of government of a province, with the aim of developing the economic potential that is characteristic of the region [5]. The development of potential industrial areas is the main focus of this research, seeing that the industry is the driving force of the economy of a region, which is able to boost competitiveness [6]. Industrial potential that is feasible to be developed in this region are: fishing, petrochemical, food and beverage, handicraft and fashion industries.

In order to determine which regions are eligible for centres of the five industries, it is necessary to consider factors that influence the industry, namely technology utilized by industries in the region [7], central and regional government policies regarding ensuring the continuity, and comfort of industrial and business operations [2,8]. Another important factor in the region, another important use is the social conditions that focus on education and culture that develops to contribute to the performance
of industrial progress [3], according to economic factors consisting of the availability of capital and raw materials [3,9,10], which have the capacity to support continuous operation of the industry. The last factor is the availability of transportation facilities that support the supply chain activities of raw materials from suppliers to consumers, as well as the distribution of results from producers to consumers [11,12].

Looking at the phenomena explained in the previous explanation, this research will focus on determining the potential area of industry in a regional development zone. The factors considered for determining the potential areas of industry in this study are: technology, economy, social, transportation and policy.

2. Literature review

Research that has taken place in the field of technology is carried out by Roig-Tierno [5]; Otay and Kahraman [7], who discuss the use of AHP, to determine the technology used in an industrial area, which is in line with the research conducted. Economic factors pay more attention to the availability of raw materials [3,6,9] and which, as well as improving the economic level through the opening of business opportunities, in line with research conducted. The research is also in line with the focus of observation in the form of social factors in determining the location of potential industrial development areas that pay attention to aspects of education and culture to improve industrial performance, as stated by Roig-Tierno [5]; Khaira and Dwivedi [6]; Singh [13]. The transportation factor pays more attention to the infrastructure of facilities and utilities, supporting the supply of raw materials and the distribution of results, as stated by Costa et al. [10]; Ko [14]; Pereira et al. [15]. The final factor is policy, where this research focuses on the availability of regulations that guarantee business continuity, as stated by Terouhid et al. [2]; Gothwal and Saha [16].

The development of research in the field of assignment method, divided into two major parts, namely the development of methods and applications. Research on improving methods is directed at improving algorithms with both linear and fuzzy programs carried out by Zavlanos et al. [17]; Khandelwal [18], while Alkailany [19]; He et al. [20] improves the condition of distribution channels in the case of traveling salesmen. In the field of application, it is divided into several aspects, namely the application of parallel machine scheduling, which is carried out by Won and Kim [21], determination of the profitability of multiple businesses by Chen [22], multi-criteria decision making by Weiss [23]. The research is in line with what was done by Won and Kim [21]; Chen [22].

3. Method

Noting that there are five potential areas of industry, with the selection criteria influenced by technological, social, economic, transportation and policy factors, this phenomenon is a characteristic of multi-criteria decision making or called MCDM. In this research, a qualitative MCDM model will be utilized by using the analytical hierarchy process (AHP), to produce priority assessment weights, derived from the preferences of stakeholders consisting of government, society, industry players and investors with stakeholders who were respondents numbered forty from each area. After obtaining weights for each industry contained in the five areas, the next step is to determine the industry priorities that will be developed in each region using the assignment method.

The research steps to obtain potential industrial areas are described as follows:

3.1. Step 1 (survey)
At this stage a questionnaire was distributed to respondents, which were found in five areas. Each area was taken as many as forty respondents.

3.2. Step 2 (applying the AHP model)
At this stage the respondent's data is used as input for the AHP model, so we get the weight of each area based on influential factors. At this stage the AHP model was utilized five times by utilizing expert choice software version 11.

3.3. Step 3 (applying the model assignment method)
At this stage the weight obtained from the AHP, is used as input for the assignment method model, with the maximum objective function, so as to obtain a potential industrial development area. The AHP model calculation process is assisted with POM-QM version 4.0 software from [24].

3.4. Step 4 (analysis)
At this stage a discussion regarding the results presented from the AHP model and Assignment Method

4. Result and discussion
The initial step of this research is to draw a hierarchical diagram, which explains the relationship between industries and influential factors (Figure 1). In the picture the name of the industry is given the symbol namely the fishing industry (A), the petrochemical industry (B), the food and beverage industry (C), the handicraft industry (D), and the fashion industry (E), meanwhile area name given by 1, 2, 3, 4, and 5.

![Figure 1. Hierarchy diagram.](image)

The next step is to enter data into expert choice version 11 software. In this paper only data for industry priority area A is displayed, consisting of two, namely the comparison of preference data between factors (Figure 2), as well as the comparison between industry preferences, taking into account the factors (Figure 3). The weighting results for the lim area are presented in Figure 4 to Figure 8.

![Figure 2. Comparison preference goal criteria for priority industry area 1.](image)  ![Figure 3. Comparison preference industry priority for technology for area 1.](image)
In area 1, it can be seen that the food and beverage processing industry (C) gets the biggest weight, namely 33.1% with the support of the dominant influence of the economy (38.1%) and technology (32.6%). The food and beverage industry dominates almost all areas, thus showing that this area has the potential to be developed by the beverage and food industry. The weighted results are summarized in Figure 9, as input for the assignment method, the results of which are included in the POM-QM version 4.0 software are shown in Figure 10.

| Industry               | 1    | 2    | 3    | 4    | 5    |
|------------------------|------|------|------|------|------|
| Fishery Industry       | 24   | 23.8 | 27.6 | 27.8 | 24.4 |
| Petrochemical Industry | 13.5 | 14.1 | 12.8 | 12.8 | 17   |
| Food and Beverage      | 33.1 | 31.2 | 32.3 | 32.3 | 33   |
| Craft                  | 21.1 | 21.2 | 19.6 | 19.6 | 14.5 |
| Fashion                | 8.3  | 9.8  | 7.5  | 7.5  | 11.1 |

Figure 9. Weighted data for industry priority.
Figure 10. Assignment priority industry.

Based on the results of the assignment method presented in Figure 10, it can be concluded that in area 1 the potential to be developed by the handicraft industry, taking into account economic factors (32.6%) and technology (38.1%). This shows that the development of the handicraft industry in area one, according to respondents, must prioritize the improvement of the regional economy and the welfare of the community, which is supported by good mastery of technology by the community, where small industries are the main reference for developing regional potentials, so that area 1 becomes a central area craft development. In area 2 the fashion industry has the potential to be developed by taking into account economic factors (36.02%) and technology (25.6%). While in area 2 it has the potential to develop into the textile industry, with the main emphasis on economic development of the community, to supply raw materials to large industries, or to become small industries that supply semi-finished and finished materials to large industries, with the support of textile technology that must be mastered by the community, so that the local government is encouraged to open workshops regarding fashion products for the community.

Different with area 3, there is a strong preference for developing the food and beverage industry by taking into account economic factors (37.4%) and policy (29.6%). This condition shows that the community hopes that in area 3 the traditional beverage and food industry will be developed, which utilizes abundant agricultural materials, so that farmers do not sell agricultural products that have not added value, so as to boost the community's economy. This must be supported by the government's commitment in the form of rules and capital incentives, to encourage farmers to establish small industries in the field of food and beverages, as well as outlets to sell agricultural products such as food and beverages. In area 4 the fisheries industry has the potential to be developed by taking into account economic factors (37.4%) and policies (26.6%). Area 4 has a position close to the sea, so that the community has hopes that the government can develop the region into a fishing industry in the form of a small fishing industry, drying, cooling and canning which is expected to be able to improve the welfare of the community, supported by government regulations to run a business, with capital facilities as well as the availability of education and training facilities to improve community skills in operating the fishing industry. Area 5 deserves to be developed by the petrochemical industry, taking into account technological factors (31.2%) and transportation (20.8%). Area 5 faces severe conditions in the development of its industrial area, because the petrochemical industry requires high mastery of technology, while community knowledge and skills are inadequate, so the government needs to take steps, establishing a petrochemical technology mastery education centre, which will produce human resources to support development petrochemical industry, which must be supported by transportation facilities that can be passed by large vehicles to facilitate transportation to and from the industrial development area.

5. Conclusion
In this research, industrial development in an area is highly dominated by economic, technological, policy and transportation factors, which are used as pillars to make the region as the centre of economic drive. An important potential industry developed in this study which has a high weight is owned by the food and beverage industry, followed by the fishing, handicraft, petrochemical, and
finally, fashion industries. The AHP method has been able to help the government to make critical success factor decisions that must be considered, based on community interests, while the assignment method helps decision makers to determine the potential for industrial estate development in each region.

References
[1] Drucker P F 2006 Innovation and Entrepreneurship Practice and Principle (New York: Harper)
[2] Terouhid S A, Ries R and Fard M M 2012 Towards Sustainable Facility Location – A Literature Review Journal of Sustainable Development 5(7)18-35
[3] Boltürk E, Onar S C, Öztayşi B and Kahraman C 2016 Multi-Attribute Warehouse Location Selection in Humanitarian Logistics Using Hesitant Fuzzy AHP International Journal of the Analytic Hierarchy Process 8(2) 271-298
[4] Laporte G, Nickel S, and da Gama F S 2015 Introduction to Location Science Location Science, (Heidelberg: Springer) p 2-18
[5] Roig-Tierno N, Bavier-Puig A, Buitrago-Vera J and Mas-Verdu F 2013 The retail site location decision process using GIS and the analytical hierarchy process Applied Geography 40 191-198
[6] Khaira A and Dwivedi R K 2018 A State of the Art Review of Analytical Hierarchy Process Materials Today: Proceedings 5 4029-4035
[7] Otay I and Kahraman C 2018 Solar PV Power Plant Location Selection Using A Z-Fuzzy Number Based AHP International Journal of analytical hierarchy process 10(3) 409-430
[8] Romeijn H, Faggian R, Diogo V and Sposito V 2016 Evaluation of Deterministic and Complex Analytical Hierarchy Process Methods for Agricultural Land Suitability Analysis in a Changing Climate International Journal of Geo Information 99(5) 2-16
[9] Dağ S and Önder E 2013 Decision-Making For Facility Location Using Vikor Method Journal of International Scientific Publication 7(1) 308-330
[10] Costa J F S, Borges A R, and Machado T D S 2016 Analytic Hierarchy Process Applied to Industrial Location: A Brazilian Perspective on Jeans Manufacturing International Journal of the Analytic Hierarchy Process 8(1) 77-91
[11] Schmitt R, Quattelbaum B and Falk B 2010 Distribution of Customer Perception Information within The Supply Chain Operations and Supply Chain Management 3(2) 94-104
[12] Spens K and Wisner J 2009 A Study of Supply Chain Management Practices in Finland and the United States Operations and Supply Chain Management 2(2) 79-92
[13] Singh R K 2016 Facility Location Selection Using Extent Fuzzy AHP International Advanced Research Journal in Science, Engineering and Technology 3(2) 47-51
[14] Ko J 2005 Solving a Distribution Facility Location Problem Using an Analytic Hierarchy Process Approach International Symposium on Analytic Hierarchy Process, Honolulu Hawaii
[15] Pereira P G G, Botter R C and Robles L T 2019 Port Terminal in the Northern Region of Brazil: Decision About Public Port or Private Use Terminal International Journal of The Analytic Hierarchy Process 11(2) 195-214
[16] Gothwal S and Saha R 2015 Plant location selection of a manufacturing industry using analytic hierarchy process approach International Journal of Services and Operations Management 22(2) 235-255
[17] Zavlanos M M, Spesivtsev L and Pappas G J 2008 A Distributed Auction Algorithm for the Assignment Problem 47th IEEE Conference on Decision and Control
[18] Khandelwal A 2014 A Modified Approach for Assignment Method International Journal of Latest Research in Science and Technology 3(2) 136-138
[19] Alkailany M A S 2016 New Revised Ones Assignment Method for Solving Traveling Salesman Problem International Journal of Enhanced Research in Science, Technology & Engineering 5(6) 69-74
[20] He T, Ho W, Ka Man C L and Xu X 2012 A Fuzzy AHP Based Integer Linear Programming Model for The Multi-Criteria Transshipment Problem *The International Journal of Logistic Management* 23(1) 159-179
[21] Won Y and Kim S 1994 An Assignment Method for the Part-Machine Cell Formation Problem in the Presence of Multiple Process Routes *Engineering Optimization* 22 231-240.
[22] Idriss E M and Hussein E M M 2015 Application of Linear Programming (Assignment Model) *International Journal of Science and Research (IJSR)* 4(3) 1446-1449
[23] Chen T 2013 A linear assignment method for multiple-criteria decision analysis with interval type-2 fuzzy sets *Applied Soft Computing* 13 2735-2746
[24] Weiss H J 2005 *POM-QM for Windows Version 3.0* (New Jersey: Pearson Education Inc)