Measuring Supply Chain Performance through Migrant Workers Placement

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Abstract— To facilitate existing procedures and improve decision making, a decision support system (SPK) needs to be built. This SPK aimed to determine the placement of workers abroad using the Simple Additive Weighting (SAW) method and supply chain process. This method was chosen because it is able to select the best alternative from a number of alternatives, in this case the alternative in question was someone who was entitled to receive Placement based on predetermined criteria. This research was conducted by looking for weight values for each individual. The Decision Support System produced was capable of ranking prospective Indonesian migrant workers and making it easier for BP3TKI to make decisions about Indonesian migrant workers by supply chain resource management for who will depart abroad.

Keywords— *Supply chain, Decision support system, Indonesian migrant workers placement, Simple Additive Weighting.*

1. Introduction

1.1. Background

Improving the performance of supply chain processes by coordinated application of inventory management and capacity management is considered in this research. Indonesia is a country with dense population, but Indonesia does not have enough employment to improve the living standards. This encourages many residents to become Indonesian migrant workers. However, Indonesian migrant workers who are eligible to be hired abroad must have specific criteria, namely: age, education, knowledge, work experience and language. These criteria become a reference in the process of selecting the placement of Indonesian sbroad workers. BP3TKI Bandar Lampung is a government agency that coordinates, carries out the registration and selects the Indonesian migrant workers and their placement locations.

In the constitutionof Republic of Indonesia No. 39 of 2004 about the Placement and Protection of Indonesian Migrants Workers, TKI is every Indonesian citizen who meets the requirements to work abroad in an employment relationship for a certain period by receiving salary [1-4].

This constitution also states that the determination of worker placement or worker selection is the process of finding worker to select candidate that are meet the criteria that are in accordance with the character of the job being applied for. The placement of Indonesian worker abroad is determined based on age, knowledge, work experience, and education, language criteria [5-10].

The National Agency for Placement and Protection of Indonesian Migrant Workers called BP3TKI is technical implementation unit of BNP2TKI that carries out registration and selection of prospective migrant workers and their placement. During this time the decision making process for the placement of Indonesian migrant workers that will be sent abroad at the selection stage of prospective migrant workers in BP3TKI, it was done by selecting the completeness of the requirements of documents that must be met by prospective migrant workers. The procedure that runs up to the present, in general has been able to determine the placement of prospective TKI dispatched to work abroad. However, the procedure needs to be improved in terms of the quality of decision making supported by the Decision Support System in making decision on determining employment abroad [11-14].

The responsibility of the government in providing protection to Indonesian workers abroad is obliged to provide protection and guarantee of right of all Indonesian workers. The legal protection provided by the government can be seen from the legal instruments and policies issued by the government, in relation to the government's responsibility in

providing protection for Indonesian worker who works abroad at the local government level, as well as the responsibilities of the central and regional governments, the National Agency for the Placement and protection of Indonesian Workers (BNP2TKI) Ministry of Manpower and Transmigration (Kemenakertrans.), Embassy of the Republic of Indonesia (KBRI) as well as (KJRI), with efforts to protect legal aid based on legislation in force in the destination country and international customs [15-17]. Application of the protection of Indonesian workers (TKI) abroad is the guarantee of the rights of Indonesian workers, especially those who work abroad starting from the period of pre-placement, placement period or post-placement. This can be seen from the provision of Article 77 paragraph (1) and (2), Article 80, and Article, Constitution of the Republic of Indonesia Number 39 of 2004 concerning Placement and Protection of Indonesian Migrant Workers Abroad [2-4]. lack of health protection for migrant workers, including:

1) Lack of education provided by the PPTKIS and government agencies in Indonesian labor migrants is related to the knowledge of the basic rights of Indonesian migrant workers themselves.
2) Lack of regional attention in assisting the settlement of health insurance problems for Indonesian migrant workers that has a lasting impact on the settlement process of insurance claims.
3) The lack of desire for Indonesian migran workers to join worker organizations so that it makes itdifficult for non-governmental organizations to provide assistance to the workers themselves. [1]

The method used in this system was Simple Additive Weigthing Method. Simple Additive Weigthing method is often known as the weighted addition method, the basic concept of Simple Additive Method weighting is to find the weighted performance ratings on each alternative on all attributes.

Simple Additive Weigthing method requires the decision matrix normalization process (X) to a scale that can be compared with all available alternative ratings. This method was chosen because it is able to select the best alternative from a number of alternatives, in this case the intended alternative is those who is entitled to receive assistance / scholarships based on predetermined criteria [18-20].

1.2. Problem Formulation

Based on title selection background, the problem that becomes the problems in this research are :

1) How to design decision support system of placement and protection of Indonesian migran workers using Simple Additive Weighting method ?
2) How to implement Simple Aditivie Weighting in Indonesian migrant worker placement ?

1.3. Problem Limitation

To make the discussion does not deviate from the goal, the following problem boundaries are given:

1) Pengambilan data untuk penelitian ini diperoleh dari PT. PUTRA BRAGAS MANDIRI CABANG LAMPUNG,
2) Data collection for this research were obtained from PT. PUTRA BRAGAS MANDIRI CABANG LAMPUNG,
Pasirijuk sub district, Pringsewu district.
3) In this research, it was used five criteria namely Age, Education, Knowledge, Work Experience and Language.

1.4. Research Purpose

As for the purpose of this research was to determine Indonesian migrant workers placement from PT. PUTRA BRAGAS MANDIRI CABANG LAMPUNG, Pasirijuk sub district, Pringsewu district.

1) To determine better criteria and result alternative to Indonesian migrant workers candidate.
2) To design decision support system (DSS) to determine Indonesian migant workers (TKI) using Simple Additivie Weighting (SAW) method.
3) To understand more deeply to implement Simple Additive Weighting (SAW) method in determining Indonesian migrant worker placement.

2. Literature Review

2.1 Decision Support System (DSS)

Supply Chain Management (SCM) is, today, a familiar management terminology. Although supply chains in industries have been in existence for quite some years, it is only in the last decade or so that SCM has begun to be viewed and treated as a strategic component of business management. Decision Support System (SPK) is an interactive computer-based system, which helps decision makers to use data and various models to solve unstructured problems. Decision support system integrates resources
intellectuals from individuals with computer capacity to improve decision quality.

According to Alter Decision Support System is an interactive information system that provides information, modeling, and data manipulation. The system is used to help decision making in semi-structured situation and unstructured situation, where no one knows for sure how a decision should be made [18, 19].

According to Turban, the purposes of DSS are :
1) To help manager in making decision for semistrcture problem.
2) To give support for manager consideration and not aimed to change manager function.
3) To improve decision effectiveness taken by manager more than its eficiency improvement.
4)
Computing speed. Computers allow decision makers to do a lot of computing quickly at low costs.
5) Increased productivity. Building a group of decision makers, especially experts, can be very expensive. Computerized support can reduce group size and the possibility of its members to be in different location. In addition, productivity of support staff (eg financial and legal analysis) its productivity can be increased using optimization tools that determine the best way to run a business.
4) Quality support. Computer can improve the quality of decisions made. For example, the more data were accessed, the more alternatives can be evaluated. Risk analysis can be done quickly and the views of experts (some of whom are distant locations) can be collected quickly and at a lower cost. Expertise can even be taken directly from a computer system through artificial intelligence methods. With computers, decision makers can carry out complex simulations, examine many possible scenarios, and assess various influences quickly and economically. All of these capacities lead to better decisions [20].
5) Competitiveness. Management and empowerment of company resources. Competition pressure causes decision-making tasks to be difficult.
Competition is based not only on price, but also on quality, speed, product customization, and customer support. Organizations must be able to change the mode of operation frequently and quickly, reengineer processes and structures, empower employees, and innovate. Decision-making technology that can create significant empowerment by allowing someone to make good decision quickly, even if they have less knowledge.
6) to overcome cognitive limitation in processing and deviation. The human brain has limited ability to process and to store information. People sometimes have difficulty in remembering and using information in error-free ways.

2.2 Simple Additive Weigthing (SAW)

The SAW method is often also known as the weighted addition method. The basic concept of SAW method is to find the weighted addition of the performance rating on each alternative to all attributes. The SAW method requires the decision matrix normalization process (X) to a scale that is compared to all existing ratings.

$$r_{ij} = \begin{cases} \dfrac{X_{ij}}{\text{Max } x_{ij}} & \text{Jika j adalah atribut keuntungan (benefit)} \\ \dfrac{\text{Min}_{ij}}{X_{ij}} & \text{Jika j adalah atribut biaya (cost)} \end{cases} \quad (3)$$

Where rij is normalized performance rating from Ai alternative of Cj attribute; i =1,2....m and j =1,2...n. Preference score for each alternative (Vi) is as follows :
Vi = 1
descr
Description :
Vi = Preference score
Wj = Ranking weight
Rij = Normalized performance rating
Greater Vi score indicates selected Ai alternative.
As for the steps of this research are :
1) Mendefnisikan masalah dan menentukan solusi yang diinginkan.Define problem and its desired solution.
2) Create hierarchy structure that begins with purpose, reference criteria in decision making namely Ci and posibility of alternative at low level.
3) Determine compatibility rating for each alternative at each criterion
Create decision matrix based on Ci criteria then perform matrix normalization based on adjusted equation with (benefit attribute or cost attribute) so it is obtained R normalized Matrix.
4) Final result is obtained from ranking process, that is addition from R normalized multilplication matrix with weighted vector so it is obtained selected score as best alternative (Ai) as solution.

2.3 Definition of Indonesian Migrant Workers

Indonesian Migrant Workers (TKI) are every Indonesian citizen who meets the requirements to work abroad in an employment relationship for a certain period by receiving a salary.
On the other hand, as stated by Satjipto Rahardjo, there is nothing better and more precise in the configuration of Indonesian society than by saying that the community is changing rapidly and is quite basic. Indonesia is a community that is undergoing structural transformation, namely from an agriculture-based society to an industrial base. These changes have accelerated, namely since the use of technology is increasingly become a mainstay mode to solve government policy and program problems regarding the placement of Indonesian Migrant Workers (TKI) abroad is one solution to reduce unemployment in the country, by utilizing employment opportunities abroad , Tki not only earns substantial income, but also contributes foreign exchange to the Indonesian.

3. Research Method

The research method is a theoretical framework that is used to analyze, work on or overcome the problems faced. While the theoretical framework or scientific framework is scientific methods that will be applied in the implementation of tasks

3.1 Data Collection

3.1.1 Direct observation

To collect accurate evidence, author also conducted research directly by visiting branch office of PT PUTRA BRAGAS MANDIRI to obtain general illustration about office and risk management of information system from that office.

3.1.2 Interview

Interview is data collection method by conducting activities to talk directly with the PT in the research place, for the material for the design and construction of Decision Support Systems in the context of Placement in the PT. To get information about how to work from PT. PUTRA BRAGAS MANDIRI BRANCH LAMPUNG, the author directly interviewed the owner of the PT.

3.1.3 Literature Research Study

This method is data collection technique from some references that consist of file. This data collection technique with reference from file from school, internet, research journal and others.

3.2 Simple Additive Weigthing (SAW) Method

The SAW method is often also known as the weighted addition method. The basic concept of the SAW method is to find the weighted sum of performance rating on each alternative on all attributes.
The SAW method requires the decision matrix normalization process (X) to a scale that is compared with all existing ratings.

$$r_{ij} = \begin{cases} \dfrac{X_{ij}}{\text{Max } x_{ij}} & \text{Jika j adalah atribut keuntungan (benefit)} \\ \dfrac{\text{Min}_{ij}}{X_{ij}} & \text{Jika j adalah atribut biaya (cost)} \end{cases} \quad (3)$$

Where rij is normalized performance rating from Ai alternative at Cj; i =1,2...m and j =1,2...n. Preference score for each alternative (Vi) is obtained as :
Vi = =1
Reference :
Vi = Preference score
Wj = Ranking weight
Rij = Normalized performance rating
Greater Vi score indicates Ai alternative is more selected
As for some steps in this research of SAW method are :
1) Define problem and determine desired solution.
2) Create a hierarchical structure that begins with the objectives, the criteria that will be used as a reference in decision making, namely Ci and possible alternatives at the lowest level.
3) Determine compatibility rating for each alternative at each criterion.
4) Make a decision matrix based on CI criteria), then normalize the matrix based on the equation adjusted for the type of attribute (profit attribute or cost attribute) so that obtained the normalized R matrix.
5) The final result is obtained from the ranking process which is the sum of the normalized R matrix multiplication with the weight vector so that the largest value is chosen as the best alternative (Ai) as the solution.

3.2.1 Weighting Criteria

In this research there are weight and criteria needed to determine who will be selected as Indonesian Migrant Workes that will be placed. As for the criteria are :

C1 = Age	C1= Very good
C2 = Knowledge	C2= Good
= Working	
C3 experience	C3= Fairly good
C4 = Education	C4= Less good
C5 = Language	C5= Not good

For each criterion has the results and its weight. It can be seen at tables with the weight
Berikut dapat dilihat pada Table-Table tentang setiap kriteria beserta bobotnya.

Table 1. Criteria 1 (C1) Age

Age (X)	Weight
X ≥ 18 ≤ 20	5
X ≥ 21 ≤ 23	4
X ≥ 24 ≤ 26	3
X ≥ 27 ≤ 30	2
X ≥ 31 ≤ 35	1

Table 2. Criteria 2 (C2) Knowledge

Knowledge	Weight
Making cake	1
Cook	1
Sew	1
Design the Cloth	1
Take care of child	1

Description :
If : Person (Y) master 1 knowledge so the score is 1
If : Person (Y) master 2 knowledge so the score is 2
If : Person (Y) master 3 knowledge so the score is 3
If : Person (Y) master 4 knowledge so the score is 4
If : Person (Y) master 5 knowledge so the score is 5

Table 3. Criteria 3 (C3) Working experience

Working experience	Weight
Y = 0 Year	0
Y ≥ 1 ≤ 3 Years	1
Y ≥ 4 ≤ 6 Years	2
Y ≥ 7 ≤ 9 Years	3
Y ≥ 10 Years	4

Table 4. Criteria 4 (C4) Education

Education	Weight
Elementary school	1
Junior high school	2
Senior high school	3
Diloma 1 – Diploma 3	4
Bachelor	5

Table 5. Criteria 5 (C5) Language

Language	Weight
English	1
Malay	1
China	1
Arab	1
Bahasa Indonesia	1

Description :
If : Person (Y) master 1 language so the score is 1
If : Person (Y) master 2 languages so the score is 2
If : Person (Y) master 3 languages so the score is 1
If : Person (Y) master 4 languages so the score is 4
If : Person (Y) master 5 languages so the score is 5

3.2.2 Weighting

Table 6. Vector weight for each criteria

Criteria	Weight
C1	30 %
C2	20 %
C3	20 %
C4	15 %
C5	15 %
Total	100 %

3.3.Weighting criteria (Explanation from C1-C6)

Table 7. Criteria 1 (C1) Age

Age (X)	Weight
X ≥ 18 ≤ 20	5
X ≥ 21 ≤ 23	4
X ≥ 24 ≤ 26	3
X ≥ 27 ≤ 30	2
X ≥ 31 ≤ 35	1

Table 8. Criteria 2 (C2) Knowledge

Knowledge	Weight
Make cake	1
Cook	1
Sew	1
Design the Cloth	1
Take care of child	1

Description :
If : Person (Y) master 1 knowledge so the score is 1
If : Person (Y) master 2 knowledge so the score is 2
If : Person (Y) master 3 knowledge so the score is 3
If : Person (Y) master 4 knowledge so the score is 4
If : Person (Y) master 5 knowledge so the score is 5

Table 9. Criteria 3 (C3) Working experience

Working experience	Weight
Y = 0 year	0
Y ≥ 1 ≤ 3 years	1
Y ≥ 4 ≤ 6 years	2
Y ≥ 7 ≤ 9 years	3
Y ≥ 10 years	4

Table 10. Criteria 4 (C4) Education

Education	Weight
Elemntary school	1
Junior high school	2
Senior high school	3
Diploma 1 – Diploma 3	4
Bachelor	5

Table 11. Criteria 5 (C5) Language

Language	Weight
Englih	1
Malay	1
China	1
Arab	1
Indonesia	1

Description :
If : Person (Y) master 1 language so the score is 1
If : Person (Y) master 2 languages so the score is 2
If : Person (Y) master 3 languages so the score is 1
If : Person (Y) master 4 languages so the score is 4
If : Person (Y) master 5 languages so the score is 5

Table 12. Vector weight for each criterion

Criteria	Bobot
C1	30 %
C2	20 %
C3	20 %
C4	15 %
C5	15 %
Total	100 %

4. Planning and Implementation

4.1 Alternative weighting at each criteria

Table 13. Alternative weighting

Candidate	Criteria				
	C1	C2	C3	C4	C5
A1	5	3	1	3	3
A2	4	2	1	3	2
A3	3	3	2	4	4
A4	2	3	2	5	5
A5	3	4	1	4	5

4.2 Normalization of each criterion

Benefit criterion (C1,C2,C3,C4,C5)

$r_{ij} = (X_{ij}/\max \{X_{ij}\})$

From C1 column the maximum score was 5, so each row from C1 column was divided by :
So each row from C1 column was divided by score maximum score of C1 column.
$r_{1.1} = 5/5 = 1$
$r_{2,1} = 4/5 = 0,8$
$r_{3,1} = 3/5 = 0,6$
$r_{4,1} = 2/5 = 0,4$
$r_{5,1} = 3/5 = 0,6$
From C2 column the maximum score was 5, so each row from C2 column was divided by :
So each row from C2 column was divided by score maximum score of C2 column.
$R_{1,2} = 3/4 = 0,75$
$R_{2,2} = 2/4 = 0,5$
$R_{3,2} = 3/4 = 0,75$
$R_{4,2} = 3/4 = 0,75$
$R_{5,2} = 4/4 = 1$
From C3 column the maximum score was 5, so each row from C3column was divided by :
So each row from C3 column was divided by score maximum score of C3 column.
$R_{1,3} = 1/2 = 0,5$
$R_{2,3} = 1/2 = 0,5$
$R_{3,3} = 2/2 = 1$
$R_{4,3} = 2/2 = 1$
$R_{5,3} = 1/2 = ,5$
From C2 4column the maximum score was 5, so each row from C4 column was divided by :
So each row from C4 column was divided by score maximum score of C2 column.
$R_{1,4} = 3/5 = 0,6$
$R_{2,4} = 3/5 = 0,6$
$R_{3,4} = 4/5 = 0,8$
$R_{4,4} = 5/5 = 1$
$R_{5,5} = 4/5 = 0,8$
From C5 column the maximum score was 5, so each row from C5 column was divided by :
So each row from C5 column was divided by score maximum score of C5 column.
$R_{1,5} = 3/5 = 0,6$
$R_{2,5} = 2/5 = 0,4$
$R_{3,5} = 4/5 = 0,8$
$R_{4,5} = 5/5 = 1$
$R_{5,5} = 5/5 = 1$

4.3 Normalized factor table

C1	C2	C3	C4	C5
1	0,75	0,5	0,6	0,6
0,8	0,5	0,5	0,6	0,4
0,6	0,75	1	0,8	0,8
0,4	0,75	1	1	1
0,6	1	0,5	0,8	1

4.4 Calculation

By multiplying each column at Table with declared criteria weight by using equation :
$\sum$

V1 = (0,3 x 1) + (0,2 x 0,75) + (0,2 x 0,5) +

(0,15 x 0,6) + (0,15 x 0,6)

= 0,3 + 0,15 + 0,1 + 0,09 + 0,09
= 0,73

V2 = (0,3 x 0,8) + (0,2 x 0,5) + (0,2 x 0,5) + (0,15 x 0,6) + (0,15 x 0,4)
= 0,24 + 0,1 + 0,03 + 0,09 + 0,6

= 0,52

V3 = (0,3 x 0,6) + (0,2 x 0,75) + (0,2 x 1) + (0,15 x 0,8) + (0,15 x 0,8)

= 0,18 + 0,15 + 0,2 + 0,12 + 0,12
= 0,77

V4 = (0,3 x 0,4) + (0,2 x 0,75) + (0,2 x 1) +

(0,15 x 1) + (0,15 x 1)
= 0,12 + 0,15 + 0,2 + 0,15 + 0,15
= 0,77
V5 = (0,3 x 0,6) + (0,2 x 1) + (0,2 x 0,5) +

(0,15 x 0,8) + (0,15 x 1)
= 0,18 + 0,2 + 0,03 + 0,12 + 0,15
= 0,68
From the calcualtion above it waas obtained score as follows :
V1 = 0,73
V2 = 0,52
V3 = 0,77
V4 = 0,77
V5 = 0,68
So the alternative that has the three highest score and can be selected the C3 alternative with the score = 0.77, C5 = 0.68 and C1 = 0.73.

4.5 Impementation

Figure 1. Login menu

Figure 2. Main Menu form

Figure 3. TKI candidate data form

5. Conclusion

Supply chain orientation should be present in the entire organization across levels and should be supported by the top management. Even, in spite of its own structure, employees at all levels should be sensitized to thinking and working with a proper supply chain orientation. In fact, supply chain orientation can be combined with other HR driven outcomes, such as internal customer orientation. Based on research that has been done with the theme of decision support systems for Indonesian migrant workers placement with the Simple Additive Weigthing (SAW) method, the author takes several conclusions, namely:
1. Decision support system built can generate rangking list of Indonesian migrant workers candidate so it can ease BP3TKI to make decision about decent Indonesian migrant workes to be placed abroad.
2. Criteria data processed consist of age, education, knowledge, working experience and language.
From the conclusion that have been stated. There are some suggestion that can be applied for subsequent research. For further development, the system can be in the form of a website.

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