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Data Warehouse to Support the Decision Using Vikor Method

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Heri Muhrial[1]*, Bambang Purnomosidi.D.P[2]†, Widyastuti Andriyani[3]‡, Hamdani[1]§

1,2,3 Universitas Teknologi Digital Indonesia Yogyakarta, Indonesia

4 Universitas Mulawarman Samarinda, Indonesia

Abstract: Data warehouse is a place where data compilations are stored extensively and periodically. The ability of the data warehouse to integrate data lightens CV. Visi Indonesia Mandiri companies in evaluating and making decisions on operational, strategic and tactical processes. The problem is that the company has not provided a data warehouse yet. Moreover, there is no service to give out the needs of easy, consistent, valid and accurate information on operational data, tactical data and strategic data from the decision-making process at the executive level. The data warehouse architecture was established as decision making using the Vikor method analysis.

Keywords: Warehouse Data • Architecture Data • ETL • Vikor Method • Decision Support System

1. Introduction

The problem existed in the modernization era in analyzing the company condition is the lack of availability of data and information that can be presented accurately, dynamically and across time. The companies which have implemented information systems in their operations are increasingly experienced difficulties in analyzing the company data records. They are increasingly abundant but static in presenting information. This can lead to difficulties, errors, and inaccuracies in analyzing data, in addition to considerable time in making decisions.

* *E-mail: heri.muhrial@gmail.com*
† *E-mail: bpdp@utdi.ac.id*
‡ *E-mail: widya@utdi.ac.id*
§ *E-mail: hamdani@unmul.ac.id*

The companies require affluent information on existing data for summary data in time dimension units, development tactical data and strategic data in decision making.

Companies often experience difficulties when they are encountered with mapping the development of information. In order that in increasingly easy information era, companies should have data to serve as tools used for the development of a company and as a comparison with other companies. However, the data must be uncomplicated, speedy and accurate in getting it. All manual data has begun to shift to digital along with technological developments that allow the process to get it automatically, periodically and in real-time. Even with technology, data can be informed quickly as in research [1] which discusses integrating the Cemerlang Skin Care branch database into the data warehouse.

Data warehouse technology simplifies to get the information needed. After collecting data sources, they will be processed to be used or utilized for future needs. To get some of the data sources needed, a test is required to get them [2]:

1. The first data source is an internal data source used by the company in operational activities. The urge for testing to engineer the data from raw data and processed and then saved to a data warehouse to be utilized for the company

2. The second data source is an external data source which will be used by the company to carry out tactical and strategic actions in operational activities

Theoretical Review

Several previous studies related to data warehouse design [3] Data Warehouse Design in Software Laboratory Center which discusses how to analyze the databases [4] Data Warehouse Design and Analysis which discusses analyzing database support in assisting the decision making [5]. Data Warehouse Model Design in support the shipping service companies which talks about the data warehouse. It is one of the concepts which oriented to the center component in a company, to be exact the data [6]. Identification of Distributor Status, and Extension of Distributor Active Period which explores the data analysis regarding sales from stockiest to distributors, identification of distributor status, and extension of distributor active period [7]. Data Warehouse Design and Implementation for Product Sales Prediction discusses about predicting the most sought-after or in-demand products [8]. In correlated research to the Implementation of the Vikor Method for Scholarship Admissions which discusses the admission of scholarship recipients who still register manually [9]. Moreover, they apply the Vikor Method in the Ministry of Communication and Informatics, carry out communication and informatics services to the community and supervise and control the licensing in the Communication and

Information scope toward the government and the public. For this reason, the Department of Communication and Information of Deli Serdang Regency recruits experts with predetermined criteria [10].

2. Methods

2.1. Snowflakes Schema Design

In this stage, the activities carried out are based on creating a dimensional data model in the form of a snowflake schema and then making the ETL process which will be the center of the schema. In this design a fact table is constructed which is called fa_experience. Meanwhile, other data are formed into dimension tables and sub-dimensions, all of which are related to the fact table according to, can see on Figure 1.

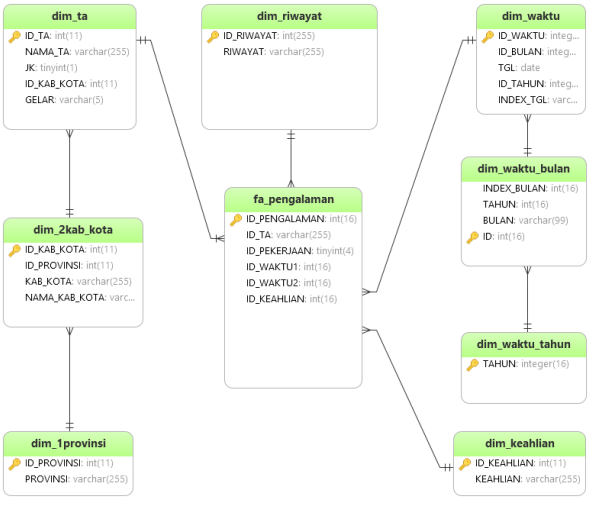

Figure 1: ERD

2.2. System Design

In the system design, internal and external data sources are processed with ETL according to [11] which is then kept into the data warehouse and then analyzed using the Vikor method which leads to a ranking of expert data for the design of the Opinion Data Architecture as illustrated in the Figure 2 below.

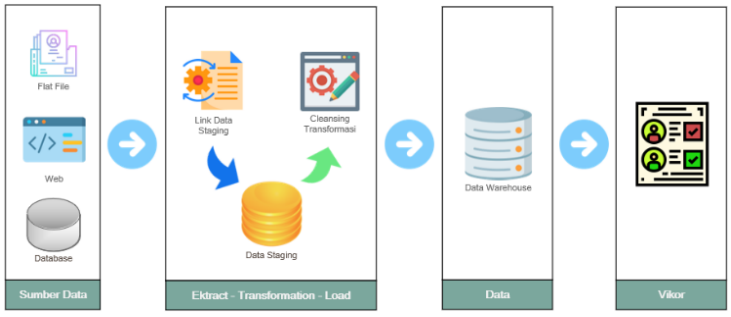

Figure 2: System Design

3. ETL Pipeline Warehouse Data

3.1. Data Extraction

The data source consists of the company's internal data in the form of doc, pdf and xls files. While the external data source consists of json files taken from the website. Moreover, all data from both internal and external companies are put into the staging data with the mariadb database.

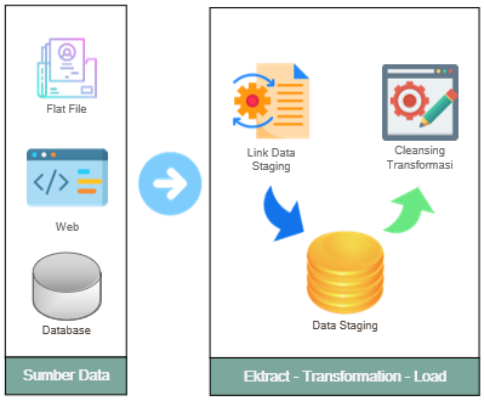

Figure 3: Data Extraction Schema

The data source consists of three parts; the first part is the internal data source which can be in the form of files such as document, pdf, excels formats which are then inputted into the staging data using the mariaDB database. In the second part, the external data source is taken from Dikti website in the form of a json file or a json url link which is then retrieved and stored in the staging data with mariaDB database. Lastly, the third part, the data is taken from an internal database owned by CV. Visi Indonesia Mandiri.

Internal data extraction process is from flat file and CV. Visi Indonesia Mandiri database which was extracted to the staging data and obtained the following data:

a. Expert Personal Data

For the expert data, they were taken from the CV. Visi Indonesia Mandiri database which can be seen in Table 1 below;

Table 1: Expert Internal Data Extraction

ID	FULL NAME	EDUCATION	EXPERIENCES
20002	DIDI NURYADIN	S2/Master Degree	20
20003	HENRI KRISMAWAN	S2/Master Degree	7
20004	Hermawan Prasetya, SE	S1/Bachelor Degree	12
20005	Amad Saeroji, S.S, M.Sc	S2/Master Degree	5
20006	Dr. Ir. Widodo.,MP	S2/Master Degree	29
...	...	...	...
20021	Desi Ariani, SP	S1/Bachelor Degree	4
20022	MOHAMMAD KHOIR, S.Hum	S1/Bachelor Degree	2

b. Expert Curriculum Vitae

From the internal data of CV. Visi Indonesia Mandiri, it was obtained historical data from the experts as shown in Table 2 below;

Table 2: The Extraction of Expert History Internal Data

ID	HISTORY	INITIAL DATE	FINAL DATE
1	Digital-Based Development of Semarang City Tourism Destinations	20/08/2018	18/11/2018
2	Strategic Consultancy Services for Increasing Regional Local Revenue through Tourism Development	08/08/2017	16/12/2017
3	Priority Urban Area Development Plan	01/03/2013	15/10/2013
4	Arrangement of the RTBL for the City Center of Sumbawa Besar, Kab. Sumbawa - NTB (PBL Package R-06)	01/07/2012	01/12/2012
5	RDTR of Muara Muntai District in Kutai Kartanegara Regency	01/06/2011	01/10/2011
...	...	...	...
254	Assistance in Growing Barnacle LKMA	28/04/2014	25/07/2014
255	Profile of Coastal Zone Business Development	23/08/2014	10/11/2014
256	Entrepreneurship Training I	10/05/2014	17/05/2014

c. Expert Qualifications Data

From the internal data of CV. Visi Indonesia Mandiri also obtained Expert History Data as shown in Table 3 below;

Table 3: Internal Data Extraction of Expert Qualifications

ID	QUALIFICATIONS
1	Tourism
2	Inventory of population economic growth data
3	Reviewing business patterns run by local communities
4	Analyzing data on economic growth at the study location
5	Arranging the reports and holding discussions with the employers
6	Community Development
...	...
31	Management
32	Management
33	Public Health

The External Data Extraction Process on the Dikti website to the staging data will attain the following data:

a. Lecturer Personal Data

Lecturer data taken from website as shown in Table 4 below;

Table 4: Lecturer Personal Data

ID_TA	20023
ID_TA_DIKTI	488DD6EB-4A9F-4664-A16A-0BA36DB3A91A
FULL_NAME	ANGELA ARIANI
NICKNAME	
EDUCATION	S2
JK	0
EXPERIENCE	19
AT_CREATE	07/10/2021 20:49
AT_UPDATE	09/10/2021 01:43

b. Lecturer Teaching History Data

For the lecturer data taken from website can be seen in Table 5 below;

Table 5: Lecturer Teaching History Data

ID	ID_TA	ID_SMT	ID_MK	NM_MK
1	20023	20021	22111	PENGANTAR PARIWISATA
2	20023	20021	23313	PERENCANAAN PERJALANAN WISATA II
3	20023	20021	22111	PENGANTAR PARIWISATA
4	20023	20021	22111	PENGANTAR PARIWISATA
5	20023	20021	23313	PERENCANAAN PERJALANAN WISATA II
...	...	...	...	...
858	20025	20202	52411	BAHASA INGGRIS PARIWISATA II
859	20025	20202	52209	BAHASA INGGRIS DASAR II

c. Lecturer Education Data

For the lecturer education data taken from website can be observed in Table 6 below;

Table 6: Lecturer Education Data

GRADUATE	NM_SP_FORMAL	LEVEL	TITLE
1997	Universitas Islam Malang	S1	S.H.
2011	Sekolah Tinggi Ilmu Ekonomi Pariwisata Indonesia	S2	M.M.

3.2. Transformation

After creating the data link and successfully retrieving the data and saving it to the mariaDB database staging data, then the process of selecting the data to analyze and predict the process is carried out with data preparation as follows:

Figure 4: Data Transformation Scheme

In the data transformation process, it will be ensured based on the needs of Vikor data analysis. Then the table structure with the data warehouse method has been previously designed with the following design and two table criteria.

3.3. Fact Table

In the staging data, the experts experience data will be transformed into a fact table to be inputted into the data warehouse. It is to form a fact table for the experts experience namely *fa_experience* table. It serves to calculate the total experience of the experts and also as the 1^{st} parameter class.

3.4. Dimension Table

In the staging data, other expert data will be transformed into the database table with the following dimensions:

Table 7: Database Description Table

Table Name	Table Description
dim_ta	for the dimension table of experts, it is used to accommodate the contents of short profiles of experts such as degree data which will be used for Vikor data analysis
dim_riwayat	the historical dimension table is used to accommodate the experiences that have been carried out by experts
dim_waktu	for the time dimension table is to store job history time index
dim_waktu_bulan	for time dimension table is to store month time index
dim_waktu_tahun	for time dimension table is to store year time index
dim_keahlian	for the dimension table of expertise data on experts
dim_1provinsi	for the provincial dimension table is to store the location
dim_2kab_kota	for the district/city dimension table is to store the location of the experience history

Based on the fact table and dimension table, the following data transformation is needed:

a. Transformation of date into the number of years of the Experts experience as shown in Table 8 below

Table 8: Transformation Calculation of Expert Experience.

ID_TA	FULL NAME	EXPERIENCE IN MONTH	EXPERIENCE IN YEAR
20002	DIDI NURYADIN	244	20
20003	HENRI KRISMAWAN	88	7
20004	Hermawan Prasetya, SE	142	12
20005	Amad Saeroji, S.S, M.Sc	64	5
...	...	...	...
20021	Desi Ariani, SP	52	4
20022	MOHAMMAD KHOIR, S.Hum	27	2

b. Transformation of the birth date data into the experts' age by updating the age column using a query.

```
UPDATE ta_db t, (SELECT ID_TA, DATE_FORMAT(FROM_DAYS(DATEDIFF(now(),
                TGL_LAHIR)), '%Y')+0 AS Age FROM ta_db) a
SET t.UMUR = a.Age
WHERE t.ID_TA = a.ID_TA;
```

Table 9: Transformation Calculate the Experts' Age

NO	FULL NAME	AGE
1	DIDI NURYADIN	47
2	HENRI KRISMAWAN	36
3	Hermawan Prasetya, SE	39
4	Amad Saeroji, S.S, M.Sc	32
5	Dr. Ir. Widodo.,MP	55
...	...	...
19	Desi Ariani, SP	38
20	MOHAMMAD KHOIR, S.Hum	35

c. The transformation of expertise data into the number of experts' qualification as shown in Table 10 below;

Table 10: Transformation to Calculate the Number of Qualification

ID_TA	FULL NAME	QUALIFICATION
20002	DIDI NURYADIN	7
20003	HENRI KRISMAWAN	2
20004	Hermawan Prasetya, SE	3
20005	Amad Saeroji, S.S, M.Sc	5
...	...	...
20021	Desi Ariani, SP	0
20022	MOHAMMAD KHOIR, S.Hum	1

d. Transformation of expert experience data into experience master data as shown in Table 11 below;

Table 11: Master Data Transformation Expert Experience

NO	EXPERIENCES
1	Household Level Food Stock Analysis in Bantul . Regency
2	Analysis of Family Planning (KB) Policy in Indonesia
3	Analysis of Inequality between Sub-District Regions as an Effort to Reduce Poverty in Sleman Regency
4	Regional Signature Product Analysis
5	Social Analysis in Slums in Bulungan Regency
...	...
226	For the Economic Business Development Assistance Service Project in the Karangsewu Location, Kulonprogo Regency (continued)
227	For Tourism Product Roadmap Preparation Project

e. Data Transformation calculates the number of lecturers' teaching experience as shown in Table 12 below;

Table 12: Lecturer Experience Transformation Calculation

ID_TA	FULL NAME	EXPERIENCE
20023	ANGELA ARIANI	19
20024	NIKASIUS JONET SINANGJOYO	19
20025	HAMDAN ANWARI	5

f. Transformation of date of birth data into lecturer's age value by updating the age column using a query.

```
UPDATE ta_db t, (SELECT ID_TA, DATE_FORMAT(FROM_DAYS(DATEDIFF(now(),
                TGL_LAHIR)), '%Y')+0 AS Age FROM ta_db) a
SET t.UMUR = a.Age
WHERE t.ID_TA = a.ID_TA;
```

Table 13: Calculation of Lecturers' Age Transformation

ID_TA	FULL NAME	AGE
20023	ANGELA ARIANI	42
20024	NIKASIUS JONET SINANGJOYO	42
20025	HAMDAN ANWARI	33

g. Transformation of lecturer experience data into experience master data as shown in Table 14 below;

Table 14: Transformation of Lecturer Experience Data

ID_RW	NM_MK
228	ANALISIS DAYA TARIK WISATA
229	ANALISIS OBYEK & DAYA TARIK WISATA
230	BAHASA INGGRIS DASAR I
231	BAHASA INGGRIS DASAR II
232	BAHASA INGGRIS PARIWISATA I
...	...
270	SISTEM INFORMASI HOTEL
271	SKRIPSI

h. Evaluate all the data needed to be inputted into the data warehouse. If it is appropriate, continue with the Data Loading process if not do data cleaning.

i. Clean the data if necessary or not, by inputting a list of data to be deleted or not included.

3.5. Data Load

After transforming the data requirements in accordance with the data warehouse structure, then the storage process is carried out to the data warehouse so that the stored data can be used for the needs of Vikor data analysis.

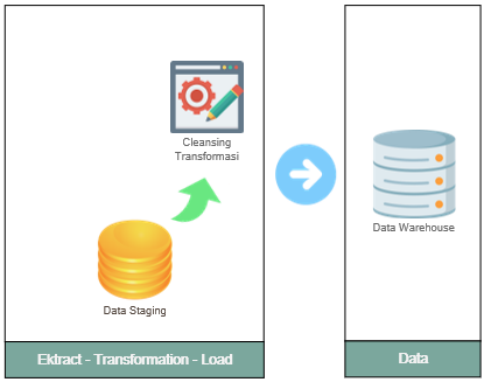

Figure 5: Warehouse Loading Data Scheme

After the extraction and transformation process of internal data and external data is carried out, the process of loading data into the data warehouse is executed so that the results of the data have been denormalized as shown in Table 15.

Table 15: The Result of the Data Load to Warehouse Data

NO	NAME_TA	GENDER	EXPERIENCE
1	DIDI NURYADIN	MAN	Preparation of Farmer's Exchange Rate (NTP) Bojonegoro Regency
2	DIDI NURYADIN	MAN	Preparation of Farmer's Exchange Rate (NTP) Bojonegoro Regency
3	DIDI NURYADIN	MAN	Preparation of Farmer's Exchange Rate (NTP) Bojonegoro Regency
4	DIDI NURYADIN	MAN	Preparation of Farmer's Exchange Rate (NTP) Bojonegoro Regency
5	DIDI NURYADIN	MAN	Preparation of Farmer's Exchange Rate (NTP) Bojonegoro Regency
...	...	...	...
851	HAMDAN ANWARI	MAN	BAHASA INGGRIS PARIWISATA III
852	HAMDAN ANWARI	MAN	BAHASA INGGRIS PROFESI I
853	HAMDAN ANWARI	MAN	BAHASA INGGRIS PROFESI III
854	HAMDAN ANWARI	MAN	BAHASA INGGRIS DASAR II
855	HAMDAN ANWARI	MAN	BAHASA INGGRIS PARIWISATA II
856	HAMDAN ANWARI	MAN	BAHASA INGGRIS PROFESI II

a. Examples of the Query Dimensions of Experts and Dimensions of History

```
# Dimensi TA x Dimensi Riwayat
SELECT xxx.ID_TA, xxx.NAMA_TA, COUNT(*) "JML RIWAYAT"
FROM (SELECT DISTINCT f.ID_TA, t.NAMA_TA, f.ID_RIWAYAT
      FROM fa_pengalaman AS f
      INNER JOIN dim_ta AS t ON f.ID_TA = t.ID_TA)xxx
GROUP BY xxx.ID_TA;
```

From the query mentioned above, it illustrates data display as shown in Table 16

Table 16: Query Results for Expert Dimensions

NO	NAME_TA	EXPERIENCES
1	DIDI NURYADIN	21
2	HENRI KRISMAWAN	15
3	Hermawan Prasetya, SE	16
4	Amad Saeroji, S.S, M.Sc	6
5	Dr. Ir. Widodo.,MP	29
...	...	...
21	ANGELA ARIANI	14
22	NIKASIUS JONET SINANGJOYO	23
23	HAMDAN ANWARI	8

b. Examples of Experts' Query Dimensions, Qualification Dimensions and History Dimensions

```
# Dimensi TA x Dimensi Keahlian x Dimensi Riwayat
SELECT t1.NAMA_TA, x1.JML_KEAHLIAN, x2.JML_RIWAYAT
FROM dim_ta t1

    LEFT JOIN
        (SELECT x.ID_TA, IF(x.KEAHLIAN <> 0, COUNT(*), x.KEAHLIAN) JML_KEAHLIAN
        FROM
         (SELECT DISTINCT r.ID_TA, IF(r.ID_KEAHLIAN IS NOT NULL, r.ID_KEAHLIAN, 0) AS KEAHLIAN FROM fa_pengalaman AS r ) x
        GROUP BY x.ID_TA) x1 ON x1.ID_TA = t1.ID_TA

    LEFT JOIN
        (SELECT x.ID_TA, COUNT(*) JML_RIWAYAT
        FROM (SELECT DISTINCT f.ID_TA, f.ID_RIWAYAT FROM fa_pengalaman AS f ) x
        GROUP BY x.ID_TA) x2 ON x2.ID_TA = t1.ID_TA;
```

From the query above, it elaborates data display as shown in Table 17 below;

Table 17: Results of Experts' Query Dimensions, Qualification and History

NO	NAME_TA	NUMBER OF QUALIFICATION	NUMBER OF EXPERIENCES
1	DIDI NURYADIN	7	21
2	HENRI KRISMAWAN	2	15
3	Hermawan Prasetya, SE	3	16
4	Amad Saeroji, S.S, M.Sc	5	6
5	Dr. Ir. Widodo.,MP	5	29
...	...	...	...
21	ANGELA ARIANI	0	14
22	NIKASIUS JONET SINANGJOYO	0	23
23	HAMDAN ANWARI	0	8

4. Vikor Method Analysis

4.1. VIKOR Method Test Data

Criterion data is data that is applied as consideration in the calculation and ranking analysis using the Vikor method. In this study, the criteria data will be weighted using the criteria weight table based on the provisions of the CV. Visi Indonesia Mandiri, as shown in Table 18

Table 18: Criterion Weight

	Decsription	W
C1	Experience	35%
C2	Education	25%
C3	Salary	20%
C4	Age	10%
C5	Qualification	10%

Weight data is used to influence the criteria in the use of the Vikor method, for details as follows:

a. Experience Criteria

Experience data is used as a parameter of the length of time the experts involved in their qualifications, projects or daily activities. Table 19 can be used to assess.

Table 19: Experience Criteria Weight

Experience Criteria	Value
< 8	1
9-12	2
13-15	3
>15	4

b. Education Experience

Education data is the latest educational parameters owned by experts, then assessed according to Table 20a.

Table 20: Criteria Value

Education Criteria	Value
D3	1
S1	2
S2	3
S3	4

(a) a. Education Criteria

Salary Criteria	Value
<= 2jt	1
> 2jt-3jt	2
> 3jt-5jt	3
> 5jt	4

(b) b. Salary Criteria

Age Criteria	Value
> 45	1
41-45	2
20-30	3
31-40	4

(c) c. Age Criteria

c. Salary Criteria

The salary criteria data are used as parameters and then assessed in Table 20b.

d. Age Criteria

Age criteria data is used as a parameter and then assessed based on Table 20c.

e. Qualification Criteria

Age criteria data is used as a parameter and then assessed based on Table 21.

Table 21: Qualification Criteria Value

The number of Qualification Criteria	Value
<= 1 Qualification	1
2 Qualifications	2
3 Qualifications	3
>= 4 Qualifications	4

Table 22: Vikor Method Data Analysis

NAME	EXPERIENCE (Year)	EDUATION	SALARY (Million)	AGE (Year)	QUALIFICATION
Didi	20	S2	7	46	7
Henri	7	S2	5	36	2
Hermawan	11	S1	5	39	3
Amad	4	S2	5	32	5
Widodo	29	S2	8.5	54	5
Suroyo	8	S2	5	34	0
Erwan	5	S2	4.5	31	0
Ridho	5	S3	7.5	36	1
Dhesi	5	S2	4.5	36	1
Syahbi	5	S2	4.5	31	1
Kelik	30	S3	10	57	1
Heri	19	S2	7	56	0
Agus	10	S2	6	33	4
Aulia	5	S1	3.5	35	1
Susanti	1	S1	1.750	32	1
Betty	5	S1	3.5	33	1
Wahyu	3	D3	1.5	33	0
Bima	6	S1	3.5	36	0
Ariani	4	S1	3	37	0
Khoir	2	S1	2.3	35	1
Angela	18	S2	7	42	0
Jonet	18	S2	7	42	0
Anwari	4	S2	5	32	0

The Vikor method is an analysis stage for the main problem in order to provide the best solution on the ranking basis. It is applied in selecting several available alternatives to be chosen as experts. The completion steps in calculating the value of the criteria using the Vikor method.

4.2. Data Normalization

The normalization and weighting are using the calculation of the Vikor method in the data Table 22. In calculating, the equation 1 is applied.

$$R_{ij} = \frac{X_j^+ - X_{ij}}{X_j^+ - X_j^-} \quad (1)$$

Known :

i = Alternative / Row as 1st data row to 23rd data

j = Criteria / Column as column data Number, Name, Experience, Education, Salary, Age and Qualificati

X_{ij} = The value of the decision-making matrix consisting of data values from rows and columns in Table 22

X_j^+ = The highest value in a criterion

X_j^- = The lowest value in a criterion

From Table 22 above, we get the results of the weighting in Table 23.

Table 23: Data Weighting Results

NO	NAME	C1	C2	C3	C4	C5
1	Didi	4	3	4	1	4
2	Henri	1	3	3	4	2
3	Hermawan	2	2	3	4	3
4	Amad	1	3	3	4	4
5	Widodo	4	3	4	1	4
6	Suroyo	2	3	3	4	1
7	Erwan	1	3	3	4	1
8	Ridho	1	4	4	4	1
9	Dhesi	1	3	3	4	1
10	Syahbi	1	3	3	4	1
11	Kelik	4	4	4	1	1
12	Heri	4	3	4	1	1
13	Agus	2	3	4	4	4
14	Aulia	1	2	3	4	1
15	Susanti	1	2	1	4	1
16	Betty	1	2	3	4	1
17	Wahyu	1	1	1	4	1
18	Bima	1	2	3	4	1
19	Ariani	1	2	2	4	1
20	Khoir	1	2	2	4	1
21	Angela	4	3	4	2	1
22	Jonet	4	3	4	2	1
23	Anwari	1	3	3	4	1

From Table 23 the value of each criterion is sought first for the highest and lowest values. Then from each criterion, data normalization will be carried out, namely:

Max Value (C1,C2,C3,C4,C5) = 4,4,4,4,4

Min Value (C1,C2,C3,C4,C5) = 1,1,1,1,1

$$R[Didi, C1] = \frac{4-4}{4-1} = \frac{0}{3} = 0$$
$$R[Jhon, C2] = \frac{4-4}{4-2} = \frac{0}{2} = 0$$
$$R[Didi, C3] = \frac{3-3}{3-1} = \frac{0}{2} = 0$$
$$R[Didi, C4] = \frac{4-1}{4-1} = \frac{3}{3} = 1$$
$$R[Didi, C5] = \frac{4-4}{4-1} = \frac{0}{3} = 0$$
$$R[Henri, C1] = \frac{4-1}{4-1} = \frac{3}{3} = 1$$
$$R[Henri, C2] = \frac{4-3}{4-1} = \frac{1}{3} = 0,3333$$
$$R[Henri, C3] = \frac{4-3}{4-1} = \frac{1}{3} = 0,3333$$
$$R[Henri, C4] = \frac{4-4}{4-1} = \frac{0}{3} = 0$$
$$R[Henri, C5] = \frac{4-2}{4-1} = \frac{2}{3} = 0,6667$$

Accomplish it up to the 23^{rd} expert data named Anwari to produce a matrix normalization table as shown in Table 24.

Table 24: Matrix Normalization

NO	NAME	C1	C2	C3	C4	C5
1	Didi	0	0	0	1	0
2	Henri	1	0,3333	0,3333	0	0,6667
3	Hermawan	0,6667	0,6667	0,3333	0	0,3333
4	Amad	1	0,3333	0,3333	0	0
5	Widodo	0	0,3333	0	1	0
6	Suroyo	0,6667	0,3333	0,3333	0	1
7	Erwan	1	0,3333	0,3333	0	1
8	Ridho	1	0	0	0	1
9	Dhesi	1	0,3333	0,3333	0	1
10	Syahbi	1	0,3333	0,3333	0	1
11	Kelik	0	0	0	1	1
12	Heri	0	0,3333	0	1	1
13	Agus	0,6667	0,3333	0	0	0
14	Aulia	1	0,6667	0,3333	0	1
15	Susanti	1	0,6667	1	0	1
16	Betty	1	0,6667	0,3333	0	1
17	Wahyu	1	1	1	0	1
18	Bima	1	0,6667	0,3333	0	1
19	Ariani	1	0,6667	0,6667	0	1
20	Khoir	1	0,6667	0,6667	0	1
21	Angela	0	0,3333	0	0,6667	1
22	Jonet	0	0,3333	0	0,6667	1
23	Anwari	1	0,3333	0,3333	0	1

Then from the normalization table it is multiplied by the weight of the criteria, and for the result using the following formula: $W_j \times W_{ij}$.

The data for the 1^{st} expert named Didi is in column C1 with value of 0 multiplied by the weight of experience criteria (C1) 0.35. Then in column C2 with value of 0 multiplied by the weight of educational criteria (C2) 0.25. Next in column C3 with value 0 is multiplied by the weight of the honor criteria (C3) 0.2. After that in column C4 with value of 1 multiplied by the weight of the age criteria (C4) 0.1 and in the last column C5 with value of 0 multiplied by the weight of the criteria of expertise (C5) 0.1. Do the normalization multiplication process with the criteria weights up to the 23rd expert data named Anwari as shown in Table 25.

Table 25: Normalization x Weight

NO	NAME	C1	C2	C3	C4	C5
1	Didi	0 x 0,35	0 x 0,25	0 x 0,2	1 x 0,1	0 x 0,1
2	Henri	1 x 0,35	0,3333 x 0,25	0,3333 x 0,2	0 x 0,1	0,6667 x 0,1
3	Hermawan	0,6667 x 0,35	0,6667 x 0,25	0,3333 x 0,2	0 x 0,1	0,3333 x 0,1
4	Amad	1 x 0,35	0,3333 x 0,25	0,3333 x 0,2	0 x 0,1	0 x 0,1
5	Widodo	0 x 0,35	0,3333 x 0,25	0 x 0,2	1 x 0,1	0 x 0,1
6	Suroyo	0,6667 x 0,35	0,3333 x 0,25	0,3333 x 0,2	0 x 0,1	1 x 0,1
7	Erwan	1 x 0,35	0,3333 x 0,25	0,3333 x 0,2	0 x 0,1	1 x 0,1
8	Ridho	1 x 0,35	0 x 0,25	0 x 0,2	0 x 0,1	1 x 0,1
9	Dhesi	1 x 0,35	0,3333 x 0,25	0,3333 x 0,2	0 x 0,1	1 x 0,1
10	Syahbi	1 x 0,35	0,3333 x 0,25	0,3333 x 0,2	0 x 0,1	1 x 0,1
11	Kelik	0 x 0,35	0 x 0,25	0 x 0,2	1 x 0,1	1 x 0,1
12	Heri	0 x 0,35	0,3333 x 0,25	0 x 0,2	1 x 0,1	1 x 0,1
13	Agus	0,6667 x 0,35	0,3333 x 0,25	0 x 0,2	0 x 0,1	0 x 0,1
14	Aulia	1 x 0,35	0,6667 x 0,25	0,3333 x 0,2	0 x 0,1	1 x 0,1
15	Susanti	1 x 0,35	0,6667 x 0,25	1 x 0,2	0 x 0,1	1 x 0,1
16	Betty	1 x 0,35	0,6667 x 0,25	0,3333 x 0,2	0 x 0,1	1 x 0,1
17	Wahyu	1 x 0,35	1 x 0,25	1 x 0,2	0 x 0,1	1 x 0,1
18	Bima	1 x 0,35	0,6667 x 0,25	0,3333 x 0,2	0 x 0,1	1 x 0,1
19	Ariani	1 x 0,35	0,6667 x 0,25	0,6667 x 0,2	0 x 0,1	1 x 0,1
20	Khoir	1 x 0,35	0,6667 x 0,25	0,6667 x 0,2	0 x 0,1	1 x 0,1
21	Angela	0 x 0,35	0,3333 x 0,25	0 x 0,2	0,6667 x 0,1	1 x 0,1
22	Jonet	0 x 0,35	0,3333 x 0,25	0 x 0,2	0,6667 x 0,1	1 x 0,1
23	Anwari	1 x 0,35	0,3333 x 0,25	0,3333 x 0,2	0 x 0,1	1 x 0,1

After the process of multiplying normalization with weights on all expert data, it will construct a data matrix as shown in Table 26.

Table 26: Normalization Result x Weight

NO	NAME	C1	C2	C3	C4	C5
1	Didi	0	0,0833	0	0,1	0
2	Henri	0,35	0,0833	0,0667	0	0,0667
3	Hermawan	0,2333	0,1667	0,0667	0	0,0333
4	Amad	0,35	0,0833	0,0667	0	0
5	Widodo	0	0,0833	0	0,1	0
6	Suroyo	0,2333	0,0833	0,0667	0	0,1
7	Erwan	0,35	0,0833	0,0667	0	0,1
8	Ridho	0,35	0	0	0	0,1
9	Dhesi	0,35	0,0833	0,0667	0	0,1
10	Syahbi	0,35	0,0833	0,0667	0	0,1
11	Kelik	0	0	0	0,1	0,1
12	Heri	0	0,0833	0	0,1	0,1
13	Agus	0,2333	0,0833	0	0	0
14	Aulia	0,35	0,1667	0,0667	0	0,1
15	Susanti	0,35	0,1667	0,2	0	0,1
16	Betty	0,35	0,1667	0,0667	0	0,1
17	Wahyu	0,35	0,2500	0,2	0	0,1
18	Bima	0,35	0,1667	0,0667	0	0,1
19	Ariani	0,35	0,1667	0,1333	0	0,1
20	Khoir	0,35	0,1667	0,1333	0	0,1
21	Angela	0	0,0833	0	0,0667	0,1
22	Jonet	0	0,0833	0	0,0667	0,1
23	Anwari	0,35	0,0833	0,0667	0	0,1

4.3. Calculating the Value of S and Determining the Maximum Value of R

After obtaining the results of the multiplication between normalization and the weights, it is applied to calculate the value of S and determine R using the formula.

Table 27: Calculating the Value of S

NO	NAME	$C1 + C2 + C3 + C4 + C5$	S
1	Didi	$0 + 0,0833 + 0 + 0,1 + 0$	0,1833
2	Henri	$0,35 + 0,0833 + 0,0667 + 0 + 0,0667$	0,5667
3	Hermawan	$0,2333 + 0,1667 + 0,0667 + 0 + 0,0333$	0,5
4	Amad	$0,35 + 0,0833 + 0,0667 + 0 + 0$	0,5
5	Widodo	$0 + 0,0833 + 0 + 0,1 + 0$	0,1833
6	Suroyo	$0,2333 + 0,0833 + 0,0667 + 0 + 0,1$	0,4833
7	Erwan	$0,35 + 0,0833 + 0,0667 + 0 + 0,1$	0,6
8	Ridho	$0,35 + 0 + 0 + 0 + 0,1$	0,4500
9	Dhesi	$0,35 + 0,0833 + 0,0667 + 0 + 0,1$	0,6
10	Syahbi	$0,35 + 0,0833 + 0,0667 + 0 + 0,1$	0,6
11	Kelik	$0 + 0 + 0 + 0,1 + 0,1$	0,2
12	Heri	$0 + 0,0833 + 0 + 0,1 + 0,1$	0,2833
13	Agus	$0,2333 + 0,0833 + 0 + 0 + 0$	0,3167
14	Aulia	$0,35 + 0,1667 + 0,0667 + 0 + 0,1$	0,6833
15	Susanti	$0,35 + 0,1667 + 0,2 + 0 + 0,1$	0,8167
16	Betty	$0,35 + 0,1667 + 0,0667 + 0 + 0,1$	0,6833
17	Wahyu	$0,35 + 0,25 + 0,2 + 0 + 0,1$	0,9
18	Bima	$0,35 + 0,1667 + 0,0667 + 0 + 0,1$	0,6833
19	Ariani	$0,35 + 0,1667 + 0,1333 + 0 + 0,1$	0,7500
20	Khoir	$0,35 + 0,1667 + 0,1333 + 0 + 0,1$	0,7500
21	Angela	$0 + 0,0833 + 0 + 0,0667 + 0,1$	0,2500
22	Jonet	$0 + 0,0833 + 0 + 0,0667 + 0,1$	0,2500
23	Anwari	$0,35 + 0,0833 + 0,0667 + 0 + 0,1$	0,6

Moreover, it is to determine the value of R

Table 28: Maximum Value of R

NO	NAME	C1	C2	C3	C4	C5	R
1	Didi	0	0,0833	0	0,1	0	0,1
2	Henri	0,35	0,0833	0,0667	0	0,0667	0,3500
3	Hermawan	0,2333	0,1667	0,0667	0	0,0333	0,2333
4	Amad	0,35	0,0833	0,0667	0	0	0,3500
5	Widodo	0	0,0833	0	0,1	0	0,1
6	Suroyo	0,2333	0,0833	0,0667	0	0,1	0,2333
7	Erwan	0,35	0,0833	0,0667	0	0,1	0,3500
8	Ridho	0,35	0	0	0	0,1	0,3500
9	Dhesi	0,35	0,0833	0,0667	0	0,1	0,3500
10	Syahbi	0,35	0,0833	0,0667	0	0,1	0,3500
11	Kelik	0	0	0	0,1	0,1	0,1
12	Heri	0	0,0833	0	0,1	0,1	0,1
13	Agus	0,2333	0,0833	0	0	0	0,2333
14	Aulia	0,35	0,1667	0,0667	0	0,1	0,3500
15	Susanti	0,35	0,1667	0,2	0	0,1	0,3500
16	Betty	0,35	0,1667	0,0667	0	0,1	0,3500
17	Wahyu	0,35	0,2500	0,2	0	0,1	0,3500
18	Bima	0,35	0,1667	0,0667	0	0,1	0,3500
19	Ariani	0,35	0,1667	0,1333	0	0,1	0,3500
20	Khoir	0,35	0,1667	0,1333	0	0,1	0,3500
21	Angela	0	0,0833	0	0,0667	0,1	0,1
22	Jonet	0	0,0833	0	0,0667	0,1	0,1
23	Anwari	0,35	0,0833	0,0667	0	0,1	0,3500

From the calculation of S value and R value in Table 27 and Table 28, the values of S+, S-, R+ and R- are obtained as shown in Table 29.

Table 29: Recap Result of S value & R value

NO	NAME	S	R
1	Didi	0,1833	0,1
2	Henri	0,5667	0,3500
3	Hermawan	0,5	0,2333
4	Amad	0,5	0,3500
5	Widodo	0,1833	0,1
6	Suroyo	0,4833	0,2333
7	Erwan	0,6	0,3500
8	Ridho	0,4500	0,3500
9	Dhesi	0,6	0,3500
10	Syahbi	0,6	0,3500
11	Kelik	0,2	0,1
12	Heri	0,2833	0,1
13	Agus	0,3167	0,2333
14	Aulia	0,6833	0,3500
15	Susanti	0,8167	0,3500
16	Betty	0,6833	0,3500
17	Wahyu	0,9	0,3500
18	Bima	0,6833	0,3500
19	Ariani	0,7500	0,3500
20	Khoir	0,7500	0,3500
21	Angela	0,2500	0,1
22	Jonet	0,2500	0,1
23	Anwari	0,6	0,3500
	$S\|R+$	0,9	0,3500
	$S\|R-$	0,1833	0,1

4.4. Calculating the Index

To calculate the index using the equation formula

$$Q(Didi) = 0.5\frac{0.1833 - 0.1833}{0.9 - 0.1833} + (1 - 0.5)\frac{0.1 - 0.1}{0.3500 - 0.1} = 0$$
$$Q(Henri) = 0.5\frac{0.5667 - 0.1833}{0.9 - 0.1833} + (1 - 0.5)\frac{0.3500 - 0.1}{0.3500 - 0.1} = 0.7674$$

Do these calculations up to the 23^{rd} data by the name of Anwari. After getting the index value, arrange the index value from the smallest value to the largest. It is to get the ranking results by the Vikor method as shown in Table 30.

Table 30: Index value results sorted

DATA	THE EXPERT NAME	VALUE	RANK
1	Didi	0,0000	1
5	Widodo	0,0000	2
11	Kelik	0,0116	3
22	Jonet	0,0465	4
21	Angela	0,0465	5
12	Heri	0,0698	6
13	Agus	0,3597	7
6	Suroyo	0,4760	8
3	Hermawan	0,4876	9
8	Ridho	0,6860	10
4	Amad	0,7209	11
2	Henri	0,7674	12
7	Erwan	0,7907	13
23	Anwari	0,7907	14
10	Syahbi	0,7907	15
9	Dhesi	0,7907	16
14	Aulia	0,8488	17
16	Betty	0,8488	18
18	Bima	0,8488	19
19	Ariani	0,8953	20
20	Khoir	0,8953	21
15	Susanti	0,9419	22
17	Wahyu	1,0000	23

Based on the Vikor Index ranking above, the smallest value is obtained, namely the 1st data by the name of Didi. Therefore based on a decision support system using the Vikor method, Didi was chosen to be an expert in CV Visi Indonesia Mandiri.

4.5. Accuracy Test Using Confusion Matrix

Confusion matrix is a matrix that represents the results of binary classification in a dataset. There are several general formulas that can be used to calculate the classification performance

4.5.1. Calculating the Number of Criteria

fter determining the criteria for each expert data as shown in Table 30, then calculate the total of each category to generate Table 31.

Table 31: Confusion Matrix Criteria Recap Table

Criteria	Total
TP	12
FN	1
FP	4
TN	6

4.5.2. Calculating the Acuracy

To calculate the accuracy in the confusion matrix, make use of the following formula;

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN} \tag{2}$$

$$Accuracy = \frac{12 + 6}{12 + 1 + 4 + 6} = 0.78$$

4.5.3. Calculating the Precision

To calculate the precision in the confusion matrix, use the following formula

$$Precision = \frac{TP}{TP + FP} \tag{3}$$

$$Precision = \frac{12}{12 + 4} = 0.75$$

4.5.4. Calculating the Recall

To calculate the recall on the confusion matrix, apply the following formula:

$$Recall = \frac{TP}{TP + FN} \tag{4}$$

$$Recall = \frac{12}{12 + 1} = 0.92$$

The results of the test can be observed on Figure 6 below.

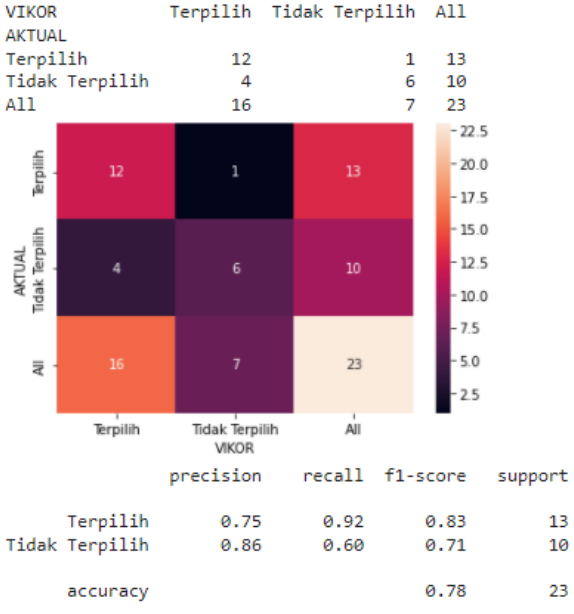

Figure 6: Method Test Results with Confusion Matrix

From the confusion matrix in Figure 6, it can be clarified that the correct ranking model has six data as negative and twelve data as positive. In addition, the model is mistaken in predicting one data into negative data which should be positive (false negative), and incorrect in predicting four data into positive data which should be negative (false positive).

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