Design of Customer Satisfaction Criteria for Telecommunications Operators: Fixed Broadband Services with DEMATEL-Based ANP (DANP) and Simple Additive Weighting (SAW) Methods

Ellin Devihana Pratiwi[1], **Catur Apriono**[2]
Department of Electrical Engineering, Faculty of Engineering, University of Indonesia.
Jl. Margonda Raya, Pondok Cina, Beji, Kukusan, Kecamatan Beji, Kota Depok, Jawa Barat 16425.
Email : [1]ellin.devihana11@ui.ac.id.

INFORMATION ARTICLE

Received 31 July 2023
Revised 27 September 2023
Accepted 06 November 2023

Keywords:
Customer Relationship Management
Customer Satisfaction
DEMATEL-Based ANP (DANP)
Simple Additive Weighting (SAW)
Telecommunications Operator

ABSTRACT

Customer dissatisfaction is an opportunity lost for telecommunications operators in fixed broadband services in expanding its market, it indicates that the criteria used in designing the loyalty program that is being provided to customers are still less precise. This research aims to provide recommendations for telecommunications operator loyalty programs for fixed broadband services based on customer satisfaction criteria. This research uses DEMATEL-Based ANP (DANP) and Simple Additive Weighting (SAW) methods to get an assessment of the loyalty program that best fits the customer satisfaction criteria. This research was conducted through questionnaires to 3 (three) fixed broadband service companies in Indonesia, where each company had 3 (three) respondents who met the requirements, namely a minimum supervisory position and a minimum working age of 10 years in the customer care sector. This research resulted in 5 dimensions and 22 criteria of customer satisfaction for telecommunications operators in fixed broadband services, where the dimension that is most influenced is resource and the dimension that is most influenced is relationship. The best loyalty program for telecommunications operators in fixed broadband services at PT X is High-Value Customer (HVC), while the worst loyalty program is Customer Application.

1. Introduction

Data from the Association of Indonesian Internet Service Providers (APJII) in 2023 shows that internet users in Indonesia continue to increase in 2023. Internet users in Indonesia reached 78.75% of Indonesia's population, namely 216 million from 274 million (IGID, 2018).

Based on Internet World Stats data, Indonesia's internet users in July 2022 reached 212 million people. With this number, Indonesia is in 8th place with the most internet users in Southeast Asia (Databoks, 2023). There are 541 million internet users in Southeast Asia out of a total population of 680 million. The number of Southeast Asia internet users reaches 10.20% of the world's total internet users (Databoks, 2023).

Data from APJII in 2023 shows that home internet occupies the second position for the type of internet service used. This type of home internet service can be an opportunity for many service providers to make a profit, especially considering the growing trend of internet usage.

Several players in Indonesia's fixed broadband share IndiHome's market share, namely First Media, MNC Play, My Republic, Biznet, and XL Home. These players only take approximately 17% of the market share, the remaining approximately 83% of the fixed broadband market share in Indonesia is still controlled by IndiHome (Spire, 2022). IndiHome is the service provider with the highest market share from September 2020 to December 2022.

Based on the annual report, the number of IndiHome subscribers continues to increase, an increase of 7.1% occurred from 2021 to 2022, and this succeeded in bringing the number of IndiHome subscribers in 2022 to 9.2 million subscribers. The increase in the number of IndiHome subscribers shows that there is still demand for the use of fixed broadband in Indonesia. IndiHome customer dissatisfaction levels are still fluctuating, tending to increase, in the last 3 years (Laporan Tahunan Telkom, 2021). This is also supported by self-requested churn data (CAPS) in Jul-Dec 2022 which tends to continue to increase (Nonatero, 2022).

Seeing that IndiHome still has a high market share, there is a great opportunity for IndiHome to gain new customers and retain old customers. Market expansion and service quality improvement are crucial factors in this regard. Therefore, it is necessary to design customer satisfaction criteria for telecommunications operators in fixed broadband services so that the loyalty program provided can suit customer needs.

2. Literature review

2.1. *Customer Satisfaction*

Customers are important intangible assets for companies, where these assets must be valued and managed (Gupta & Lehmann, 2003). Increased customer satisfaction can occur if companies can understand customers better, can increase customer value, and customers get a better experience. The achievement of customer satisfaction will make the company get loyal customers (Buttle & Maklan, 2015).

2.2. *Multi-Criteria Decision Making (MCDM)*

MCDM is one of the most popular methods to deal with complex problems that show high uncertainty, conflicting goals, different interests, and different perspectives. Also, the MCDM methodology is effective in decision making, weighing, and selection of the most suitable alternatives (Büyüközkan & Güleryüz, 2016). The MCDM approach has been classified in several ways. One of the first categorizations makes the distinction between multi-purpose decision making (MODM) and multi-attribute decision making (MADM). The main differences between the two groups of methods are based on the number of alternatives evaluated (Mendoza & Martins, 2006). The development of an MCDM for evaluation and selection was used for supplier selection, and the model for supplier evaluation and selection was successfully developed with one of the MADM methods (Xi & Qin, 2013).

2.3. *DEMATEL based on ANP (DANP)*

The DANP method combines the advantages of the three DEMATEL and ANP hybrid techniques, namely NRM of ANP, the inner dependency of ANP, and cluster-weighted ANP. The DANP method is also used to overcome the difficulties of paired comparison questions and cognitive loads taken by decision-makers in the ANP method. The following are the steps in using the DANP method (Hsu & Liou, 2013):

Step 1 - Calculate the direct effect matrix by using the score.

Managers are asked to show a direct effect that they believe factor i will have factor j as shown by a_{ij}. The contextual relationship between the factors so that the matrix A of the direct relationship can be obtained.

Step 2 - Normalization of the direct-influence matrix

Based on the direct-influence of the matrix A, the normalized direct-relation matrix (Matrix D) is obtained by using Equations (1) and (2)

$$D = sA \tag{1}$$

$$s = min\left[\frac{1}{max_i \sum_{j=1}^{n} |d_{ij}|}, \frac{1}{max_j \sum_{i=1}^{n} |d_{ij}|}\right] \tag{2}$$

Step 3 - Build a total influence matrix (Matrix T)

After a normalized direct-influence matrix D is obtained, the total influence matrix T of the Network-Relation Map (NRM) can be obtained through Equation (3), where I denote the identity matrix.

$$T = D(I - D^h)(I - D)^{-1}$$

then,

$$T = D(I - D)^{-1}, when\ h \to \infty, D^h = [0]_{n\,x\,n}, \quad (3)$$

Where $D = [d_{ij}]_{n\,x\,n}, 0 \le d_{ij} < 1, 0 < \sum_{j=1}^{n} d_{ij} \le 1, 0 < \sum_{i=1}^{n} d_{ij} \le 1$ if at least one row or column of the sum is equal to 1 (but not all) in $\sum_{j=1}^{n} d_{ij}$ and $\sum_{i=1}^{n} d_{ij}$, that we can guarantee that $\lim_{h\to\infty} D^h = [0]_{n\,x\,n}$.

Step 4 - Analyze the results.

At this stage, the number of rows $\sum_{j=1}^{n} t_{ij} = t_i$ and the number of columns $\sum_{i=1}^{n} t_{ij} = t_j$ are separately expressed as vector $r = (r_1, \dots, r_i, \dots, r_n)'$ and vectors $d = (d, \dots, d_j, \dots, d_n)'$ with Equations (4) - (6) with $i = j$ and $i, j \in \{1,2, \dots, n\}$. The horizontal axis (r+d), which describes the importance of the criterion. Moreover, the vertical axis (r-d), which can separate the criteria into groups of causes and groups of effects. When (r-d) is positive, the criteria are part of the causative group. Conversely, if the vector (r-d) is negative, the criterion is part of the effect group. A causal graph can be created by mapping the vector dataset (r+d, r-d). A causal graph provides a valuable approach to improving decision making.

$$T = [t_{ij}]_{n\,x\,n}, i, j = 1,2, \dots, n \quad (4)$$

$$r = [\sum_{j=1}^{n} t_{ij}]_{n\,x\,1} = [t_{i.}]_{n\,x\,1} = (r_1, \dots, r_i, \dots, r_n)' \quad (5)$$

$$d = [\sum_{i=1}^{n} t_{ij}]'_{1\,x\,n} = [t_{.j}]_{n\,x\,1} = (d, \dots, d_j, \dots, d_n)' \quad (6)$$

Where the vectors r and vector d state the number of rows and the number of columns of the total effect of the matrix $T = [t_{ij}]_{n\,x\,n}$, respectively, and the use of superscript shows transposition.

Step 5 – Construct an unweighted supermatrix

Construct an unweighted supermatrix to normalize each level with the total degree of effect, based on the total-effect matrix T created using DEMATEL. Then, Tc is normalized to the total degree of influence to obtain. Next, T_c^{a11} normalized using Equations (9) and (10), and repeated to get T_c^{ann}.

The total-effect matrix is normalized to build supermatrix based on group-dependent relationships. The result allows us to get unweighted supermatrix (W). Also, W^{11} and W^{12} can be obtained by using Equation (12). If space or 0 appears in the matrix, this means that the group or criterion is independent. In the same way, Wnn can be obtained.

Step 6 - Construct a weighted supermatrix

To construct the weighted supermatrix, the matrix of the total effect relationship of the T_D dimension matrix as in Equation (13). Each level and dimension of the T_D matrix is normalized to the total degree of effect to obtain T_D^a. Then, we normalize T_D^a from an unweighted supermatrix to obtain a weighted supermatrix (W^a).

Step 7- Limiting supermatrix

The last step is to get the limit supermatrix. Weighted supermatrix is multiplied by weighted supermatrix several times to get the limit supermatrix. Then, the weight of the effect for each criterion can be obtained with $\lim_{z\to\infty} (W^a)^z$.

2.4. *Simple Additive Weighting (SAW)*

The SAW is the basic model of decision-making preferences structure (Belton, 1986; Memariani & Alinezhad, 2009). SAW forms the basis of most MADM techniques (ANP, AHP, PROMTHEE, etc.) to calculate the final value of each alternative, after the weight of the evaluation system is determined (Memariani & Alinezhad, 2009; Hsu & Liou, 2013). Here are the steps in using SAW method through Equations (7) - (9) (Memariani & Alinezhad, 2009):

$$P_i = \sum_{j=1}^{k} w_j r_{ij}; i = 1, 2, \dots, m \quad (7)$$

Where rij is the normal value of the decision matrix element and is calculated as follows:

For the advantage attribute, we have:

$$r_{ij} = \frac{d_{ij}}{d_j^{Max}};\ d_j^{Max} = \underset{1 \le i \le m}{Max}\ d_{ij}; j = 1, 2, \dots, k \quad (8)$$

Moreover, for the cost attribute:

$$r_{ij} = \frac{d_j^{Min}}{d_{ij}};\ d_j^{Min} = \underset{1 \le i \le m}{Min}\ d_{ij}; j = 1, 2, \dots, k \quad (9)$$

3. Methodology

In this study, the combination model of MCDM DANP and SAW. DANP is a combination of the DEMATEL and ANP methods, where the DEMATEL model is used to obtain inter-criteria relationships and inter-dimensional relationships that will be described in the form of a Network Relation Map (NRM). The results of DEMATEL are the total influence matrix for criteria (TC) and the total influence matrix for dimensions (TD) which will be used in the DANP method. DANP uses the TC and TD matrices to form a supermatrix. The formation of the supermatrix goes through 3 stages, namely the unweighted supermatrix for criteria (WC) and dimensions (WD), the weighted supermatrix (Wa), and the limit supermatrix. The result of the formation of the supermatrix from DANP is the global weight that will be used in the SAW method according to Figure 1.

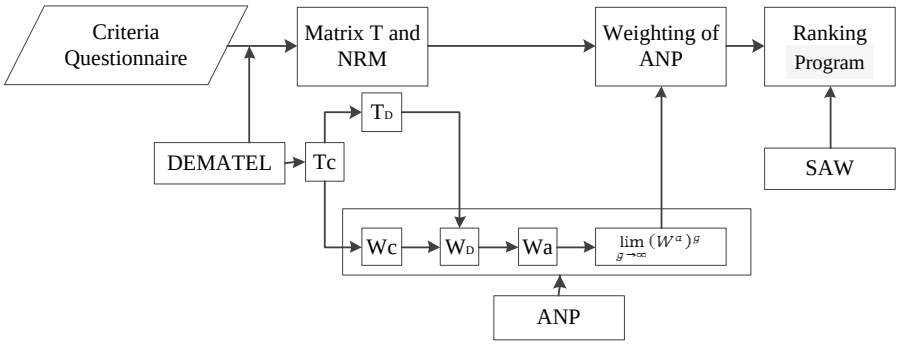


Figure 1. Processes in the DANP and SAW methods

The research stages carried out in collecting and processing data are criteria selection, criteria weighting, and program loyalty assessment.

Criteria Selection

a. Identify criteria and dimensions through literature study
b. Designing a research questionnaire for the assessment of criteria and dimensions by experts
c. Distribute questionnaires to experts
d. Selection of criteria and dimensions through assessments carried out by experts
e. Processing data from assessments carried out by experts with geometric mean to determine the selected criteria and dimensions.

f. Create an initial research model based on existing criteria and dimensions selected

Criteria Weighting

a. Identify criteria and dimensions through literature study
b. Design a research questionnaire to assess the relationship between criteria
c. Distribute questionnaires to experts
d. Assessment carried out by experts for the relationship between criteria
e. Processing data from assessments carried out by experts with DANP to understand the relationship between criteria, the relationship between dimensions, the local weight for each criterion and dimension, and the final weight for each criterion.

Program Loyalty Assessment

a. Design a research questionnaire to assess program loyalty
b. Distribute questionnaires to experts
c. Assessment carried out by experts to assess program loyalty has been done
d. Processing data from expert assessments with SAW to find out the best loyalty program.

3.1. *Criteria Selection*

The results of the literature study selected 26 criteria and 5 dimensions; it is from researchers conducted a literature review of 36 journals to obtain criteria relating to customer satisfaction for telecommunications operators: fixed broadband services. The results of the literature study from these 36 journals produced at least 154 criteria, of which these 154 criteria were then successfully selected to become 26 criteria based on the large number of journals which stated that these criteria were included in the criteria considered in the journal research. The number of journals required for these criteria to be selected at the next stage is that these criteria are considered by at least 4 of the 36 journals that have been studied by researchers.

The assessment was carried out by nine experts in designing customer satisfaction criteria for loyalty programs, with requirements for a minimum supervisory position and a minimum working age of 10 years in the field. The experts come from various telecommunications operator companies on fixed broadband as in Table 1.

Experts as Respondents will select criteria and dimensions through a questionnaire. The questionnaire uses a 5-likert scale, where one indicates "Strongly Disagree" and five indicates "Strongly Agree". The questionnaire was processed by calculating the average dimensions and criteria, where the threshold used to eliminate criteria was 3.5. Dimensions and criteria values less than 3.5 will be dimensions and criteria not considered in this study. The results of the selected dimensions and criteria are 5 dimensions and 22 criteria as in Table 2.

Table 1. Experts Personal Data

Company	Position	Field
PT X	General Mgr	CX Consumer Assurance & Fulfillment
	Manager	CX Business Process & IT Tools
	Supervisor	CX Planning & Performance
PT Y	Manager	Service Performance & Assurance
	Manager	Customer Lifecycle Management (CLM)
	Supervisor	Customer Analytics

PT Z	Manager	Customer Operation
	Manager	Acquisition, Loyalty & Retention
	Supervisor	Business Performance & Analytics

Table 2. Dimensions and Criteria of Customer Satisfaction Fixed Broadband

Dimension	Criteria
Resource (D1)	Coverage Internet Network (C1)
	Availability of Frontliners (CSR, Technicians, etc.) (C2)
	Availability of Customer Touch Points (Plasa, Apps, Web, etc.) (C3)
	Frontliner Capabilities (CSR, Technicians, etc.) (C4)
Financial (D2)	Choice of Payment Method (C5)
	Available Internet Package Options (C6)
	Available Internet Package Prices (C7)
	Provision of discounts or promos regularly (C8)
Quality (D3)	Download and Upload Speed (C9)
	Network Signal Quality (C10)
	Internet Connectivity Speed (C11)
	Internet Speed Change during Peak Hours (C12)
	Customer Data Security (C13)
Relationship (D4)	Level of Customer Perceived Value of the Product (C14)
	Optimal CRM Management (C15)
	Customer Recommendations to Relatives (C16)
	Awarding Customer Loyalty Points (C17)
	Company Provides Information Regularly to Customers (C18)
Operational (D5)	Timeliness in Overcoming Disorders (C19)
	Responsive to Customer Complaints (C20)
	New Install Request Fulfillment (C21)
	Product Development (C22)

3.2. *Weighting Criteria*

The same nine experts will assess the selected criteria by filling out a questionnaire. The questionnaire contains expert judgments about the relationship between criteria in designing customer satisfaction criteria. Assessment of the relationship between criteria uses a 5-Likert scale, where 0 indicates "Very Influential" and four indicates "Very Influential". The questionnaire will be processed by calculating the average for each relationship between criteria.

The relationship between these criteria will form a 22 x 22 matrix which will be the direct effect matrix as shown in Table 3. The next step is to normalize the direct effect matrix through equations (1) and (2). The calculation results can be seen in Table 3. In Table 3 there is a normalized direct effect matrix that can show the scale of the relationship between each criterion that already has the same basis.

From Table 4, we can construct the total effect matrix (T Matrix) via equation (3) which is the final step for DEMATEL.

Table 3. Direct-Effect Matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	Total
C1	0,000	3,000	2,222	2,111	1,111	2,556	2,333	1,778	3,111	3,889	3,667	3,222	1,333	3,333	2,667	3,778	1,444	1,889	2,444	2,889	4,000	3,111	55,889
C2	1,556	0,000	3,222	3,778	1,556	1,111	1,444	1,111	0,333	1,111	0,778	0,667	1,667	3,111	3,000	3,000	1,111	3,000	3,778	3,778	3,778	1,333	44,222
C3	2,222	3,889	0,000	3,111	3,667	2,000	2,111	2,444	0,778	0,778	0,667	1,111	2,889	3,556	3,889	3,667	2,667	3,444	3,667	3,778	3,444	1,889	55,667
C4	1,333	3,222	2,889	0,000	1,556	1,111	1,667	1,222	1,333	1,222	1,111	1,444	2,222	3,556	3,778	3,444	1,111	3,333	3,667	3,889	3,778	1,778	48,667
C5	0,667	1,444	2,667	2,111	0,000	1,222	2,000	2,667	0,889	0,778	0,667	0,556	1,889	2,222	3,000	3,444	3,000	1,889	0,889	0,778	0,778	0,889	34,444
C6	1,778	1,333	1,444	2,000	1,556	0,000	3,556	3,111	2,667	2,889	2,556	2,222	0,667	3,667	1,889	3,667	2,889	1,222	3,000	2,556	2,444	2,667	49,778
C7	2,333	1,556	2,333	2,333	1,778	3,556	0,000	3,000	3,111	3,000	3,000	2,778	1,111	3,556	2,333	3,778	3,333	2,444	2,667	2,778	3,000	3,111	56,889
C8	1,556	1,778	2,111	1,889	2,111	2,222	2,333	0,000	1,556	1,000	1,222	1,111	1,000	2,778	1,778	2,778	3,000	2,556	1,000	1,000	1,000	2,000	37,778
C9	2,000	0,889	1,000	1,778	1,111	2,333	2,444	1,222	0,000	2,333	3,111	3,333	1,111	3,333	1,667	3,889	1,444	1,667	1,889	1,667	1,444	2,111	41,778
C10	2,778	1,889	1,222	2,222	0,889	2,667	2,556	1,778	3,556	0,000	3,556	3,556	1,000	3,667	1,889	3,778	1,000	1,889	2,222	2,222	1,667	3,000	49,000
C11	2,556	2,000	1,111	1,778	0,778	2,222	2,556	2,333	3,222	2,778	0,000	3,222	1,333	3,222	2,222	3,222	1,889	1,556	2,222	2,333	2,222	3,111	47,889
C12	2,222	1,667	1,444	1,778	0,778	2,444	1,889	1,778	3,333	2,667	3,444	0,000	0,889	3,000	1,889	3,556	1,111	1,778	2,222	2,444	1,556	2,778	44,667
C13	0,667	1,111	1,778	2,222	1,222	0,889	0,778	0,889	0,444	0,444	0,444	0,556	0,000	2,889	2,889	3,444	1,111	1,778	1,000	1,111	1,000	2,222	28,889
C14	2,111	1,778	1,889	2,333	2,222	2,444	2,333	2,000	2,444	2,444	2,444	2,333	2,333	0,000	2,333	3,000	2,222	1,889	2,222	2,333	2,125	2,444	47,681
C15	1,889	2,222	2,444	2,556	2,222	2,667	2,667	2,778	1,778	1,444	1,556	1,778	2,333	3,111	0,000	3,111	2,778	2,444	2,111	2,556	2,333	2,333	49,111
C16	2,111	1,889	2,111	2,111	1,889	2,222	2,111	2,222	2,222	2,222	2,111	1,667	2,000	2,222	2,111	0,000	2,111	1,889	2,000	2,111	2,000	2,000	43,333
C17	0,889	0,778	1,222	0,889	1,778	1,778	1,667	1,778	1,000	0,778	1,333	0,778	1,333	2,778	2,333	3,333	0,000	1,778	1,111	0,889	0,778	1,333	30,333
C18	1,444	2,444	2,444	2,333	1,778	1,667	1,889	2,000	1,444	1,000	1,556	0,778	1,556	3,000	3,111	3,333	1,778	0,000	2,000	2,111	1,889	1,889	41,444
C19	1,444	2,556	2,556	2,778	1,000	1,667	1,556	2,222	1,111	1,556	1,556	0,889	1,111	3,111	2,667	3,778	1,444	2,778	0,000	2,444	1,333	2,000	41,556
C20	0,667	2,556	2,556	2,667	1,000	1,222	1,222	1,778	1,778	1,778	1,778	1,333	1,333	3,667	2,889	3,778	1,444	2,556	3,111	0,000	2,444	2,000	43,556
C21	2,556	2,778	2,667	2,444	1,556	2,556	2,444	1,889	1,444	1,444	1,444	0,889	2,000	3,333	2,556	3,444	1,667	2,444	1,778	2,000	0,000	2,111	45,444
C22	2,778	2,333	2,556	2,778	2,333	2,889	3,000	2,111	3,111	3,111	3,111	2,222	1,889	3,778	2,889	3,778	1,667	2,111	1,222	1,111	2,444	0,000	53,222
Total	37,556	43,111	43,889	48,000	33,889	43,444	44,556	42,111	40,667	38,667	41,111	36,444	33,000	66,889	53,778	73,000	40,222	46,333	46,222	46,778	45,458	46,111	73,000

Table 4. Matrix X

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22
C1	0,000	0,041	0,030	0,029	0,015	0,035	0,032	0,024	0,043	0,053	0,050	0,044	0,018	0,046	0,037	0,052	0,020	0,026	0,033	0,040	0,055	0,043
C2	0,021	0,000	0,044	0,052	0,021	0,015	0,020	0,015	0,005	0,015	0,011	0,009	0,023	0,043	0,041	0,041	0,015	0,041	0,052	0,052	0,052	0,018
C3	0,030	0,053	0,000	0,043	0,050	0,027	0,029	0,033	0,011	0,011	0,009	0,015	0,040	0,049	0,053	0,050	0,037	0,047	0,050	0,052	0,047	0,026
C4	0,018	0,044	0,040	0,000	0,021	0,015	0,023	0,017	0,018	0,017	0,015	0,020	0,030	0,049	0,052	0,047	0,015	0,046	0,050	0,053	0,052	0,024
C5	0,009	0,020	0,037	0,029	0,000	0,017	0,027	0,037	0,012	0,011	0,009	0,008	0,026	0,030	0,041	0,047	0,041	0,026	0,012	0,011	0,011	0,012
C6	0,024	0,018	0,020	0,027	0,021	0,000	0,049	0,043	0,037	0,040	0,035	0,030	0,009	0,050	0,026	0,050	0,040	0,017	0,041	0,035	0,033	0,037
C7	0,032	0,021	0,032	0,032	0,024	0,049	0,000	0,041	0,043	0,041	0,041	0,038	0,015	0,049	0,032	0,052	0,046	0,033	0,037	0,038	0,041	0,043
C8	0,021	0,024	0,029	0,026	0,029	0,030	0,032	0,000	0,021	0,014	0,017	0,015	0,014	0,038	0,024	0,038	0,041	0,035	0,014	0,014	0,014	0,027
C9	0,027	0,012	0,014	0,024	0,015	0,032	0,033	0,017	0,000	0,032	0,043	0,046	0,015	0,046	0,023	0,053	0,020	0,023	0,026	0,023	0,020	0,029
C10	0,038	0,026	0,017	0,030	0,012	0,037	0,035	0,024	0,049	0,000	0,049	0,049	0,014	0,050	0,026	0,052	0,014	0,026	0,030	0,030	0,023	0,041
C11	0,035	0,027	0,015	0,024	0,011	0,030	0,035	0,032	0,044	0,038	0,000	0,044	0,018	0,044	0,030	0,044	0,026	0,021	0,030	0,032	0,030	0,043
C12	0,030	0,023	0,020	0,024	0,011	0,033	0,026	0,024	0,046	0,037	0,047	0,000	0,012	0,041	0,026	0,049	0,015	0,024	0,030	0,033	0,021	0,038
C13	0,009	0,015	0,024	0,030	0,017	0,012	0,011	0,012	0,006	0,006	0,006	0,008	0,000	0,040	0,040	0,047	0,015	0,024	0,014	0,015	0,014	0,030
C14	0,029	0,024	0,026	0,032	0,030	0,033	0,032	0,027	0,033	0,033	0,033	0,032	0,032	0,000	0,032	0,041	0,030	0,026	0,030	0,032	0,029	0,033
C15	0,026	0,030	0,033	0,035	0,030	0,037	0,037	0,038	0,024	0,020	0,021	0,024	0,032	0,043	0,000	0,043	0,038	0,033	0,029	0,035	0,032	0,032
C16	0,029	0,026	0,029	0,029	0,026	0,030	0,029	0,030	0,030	0,030	0,029	0,023	0,027	0,030	0,029	0,000	0,029	0,026	0,027	0,029	0,027	0,027
C17	0,012	0,011	0,017	0,012	0,024	0,024	0,023	0,024	0,014	0,011	0,018	0,011	0,018	0,038	0,032	0,046	0,000	0,024	0,015	0,012	0,011	0,018
C18	0,020	0,033	0,033	0,032	0,024	0,023	0,026	0,027	0,020	0,014	0,021	0,011	0,021	0,041	0,043	0,046	0,024	0,000	0,027	0,029	0,026	0,026
C19	0,020	0,035	0,035	0,038	0,014	0,023	0,021	0,030	0,015	0,021	0,021	0,012	0,015	0,043	0,037	0,052	0,020	0,038	0,000	0,033	0,018	0,027
C20	0,009	0,035	0,035	0,037	0,014	0,017	0,017	0,024	0,024	0,024	0,024	0,018	0,018	0,050	0,040	0,052	0,020	0,035	0,043	0,000	0,033	0,027
C21	0,035	0,038	0,037	0,033	0,021	0,035	0,033	0,026	0,020	0,020	0,020	0,012	0,027	0,046	0,035	0,047	0,023	0,033	0,024	0,027	0,000	0,029
C22	0,038	0,032	0,035	0,038	0,032	0,040	0,041	0,029	0,043	0,043	0,043	0,030	0,026	0,052	0,040	0,052	0,023	0,029	0,017	0,015	0,033	0,000

Table 5. Matrix T_D

	D1	D2	D3	D4	D5
D1	0,078	0,072	0,066	0,104	0,097
D2	0,069	0,067	0,063	0,093	0,073
D3	0,066	0,064	0,063	0,086	0,073
D4	0,067	0,068	0,060	0,081	0,071
D5	0,078	0,069	0,064	0,096	0,070

Table 6. Matrix T_C

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22
C1	0,051	0,096	0,086	0,090	0,059	0,091	0,089	0,078	0,096	0,103	0,103	0,092	0,062	0,129	0,103	0,142	0,071	0,085	0,093	0,100	0,112	0,101
C2	0,059	0,046	0,089	0,100	0,057	0,059	0,064	0,058	0,045	0,053	0,051	0,044	0,058	0,108	0,096	0,112	0,056	0,088	0,098	0,099	0,098	0,064
C3	0,076	0,106	0,057	0,102	0,093	0,080	0,083	0,086	0,059	0,058	0,058	0,058	0,082	0,128	0,119	0,137	0,087	0,104	0,107	0,109	0,103	0,081
C4	0,060	0,092	0,089	0,055	0,060	0,063	0,071	0,064	0,062	0,059	0,059	0,058	0,068	0,119	0,110	0,124	0,060	0,097	0,101	0,105	0,101	0,074
C5	0,038	0,053	0,070	0,066	0,029	0,051	0,061	0,069	0,043	0,040	0,040	0,035	0,053	0,080	0,082	0,100	0,073	0,062	0,048	0,047	0,046	0,047
C6	0,068	0,067	0,069	0,081	0,060	0,051	0,099	0,090	0,084	0,084	0,083	0,073	0,048	0,123	0,085	0,130	0,085	0,069	0,092	0,087	0,084	0,088
C7	0,081	0,077	0,088	0,093	0,069	0,104	0,059	0,095	0,096	0,091	0,094	0,085	0,059	0,132	0,099	0,142	0,097	0,092	0,095	0,097	0,099	0,101
C8	0,054	0,061	0,066	0,067	0,059	0,068	0,070	0,037	0,056	0,047	0,052	0,047	0,043	0,093	0,070	0,098	0,076	0,074	0,054	0,054	0,053	0,066
C9	0,065	0,054	0,056	0,070	0,048	0,075	0,077	0,058	0,042	0,071	0,083	0,082	0,048	0,107	0,073	0,120	0,059	0,066	0,070	0,068	0,064	0,074
C10	0,081	0,074	0,066	0,084	0,051	0,086	0,086	0,072	0,096	0,047	0,096	0,091	0,052	0,123	0,085	0,131	0,060	0,077	0,083	0,084	0,075	0,093
C11	0,077	0,074	0,063	0,077	0,049	0,079	0,084	0,078	0,090	0,082	0,048	0,085	0,055	0,115	0,087	0,121	0,070	0,072	0,081	0,083	0,080	0,093
C12	0,070	0,067	0,065	0,074	0,046	0,079	0,073	0,068	0,088	0,078	0,090	0,040	0,047	0,108	0,080	0,121	0,057	0,071	0,078	0,082	0,069	0,085
C13	0,035	0,045	0,054	0,062	0,041	0,041	0,041	0,041	0,033	0,032	0,033	0,031	0,024	0,082	0,075	0,093	0,043	0,055	0,045	0,047	0,045	0,060
C14	0,070	0,071	0,073	0,083	0,067	0,080	0,080	0,073	0,077	0,075	0,078	0,071	0,068	0,072	0,089	0,117	0,074	0,075	0,080	0,082	0,078	0,083
C15	0,067	0,078	0,082	0,088	0,069	0,084	0,085	0,084	0,069	0,063	0,066	0,064	0,069	0,114	0,060	0,120	0,083	0,084	0,080	0,086	0,082	0,082
C16	0,066	0,068	0,072	0,076	0,060	0,073	0,073	0,072	0,070	0,068	0,069	0,059	0,060	0,095	0,081	0,071	0,069	0,071	0,073	0,075	0,072	0,072
C17	0,039	0,040	0,047	0,045	0,049	0,055	0,054	0,054	0,042	0,038	0,046	0,036	0,042	0,082	0,068	0,093	0,029	0,056	0,047	0,044	0,042	0,050
C18	0,055	0,074	0,075	0,077	0,058	0,064	0,068	0,067	0,057	0,050	0,059	0,045	0,054	0,102	0,092	0,111	0,063	0,045	0,071	0,073	0,069	0,068
C19	0,056	0,076	0,077	0,084	0,048	0,064	0,064	0,070	0,054	0,058	0,060	0,047	0,048	0,104	0,087	0,118	0,059	0,082	0,046	0,079	0,063	0,070
C20	0,048	0,078	0,079	0,084	0,049	0,060	0,061	0,066	0,064	0,062	0,064	0,054	0,053	0,114	0,092	0,120	0,060	0,081	0,088	0,048	0,079	0,072
C21	0,074	0,083	0,082	0,083	0,058	0,080	0,079	0,070	0,062	0,060	0,062	0,050	0,063	0,113	0,090	0,120	0,065	0,081	0,073	0,077	0,049	0,076
C22	0,084	0,084	0,088	0,095	0,074	0,093	0,095	0,080	0,093	0,090	0,093	0,076	0,067	0,130	0,103	0,137	0,073	0,085	0,074	0,074	0,089	0,057

Table 5 and Table 6 above show the results of the T matrix for each dimension and criteria. From the T matrix it can be obtained the numbers for the values (r+d) and (r-d), where the value (r+d) indicates the priority level of the dimensions/criteria, and the value (r-d) indicates the level of influence of the dimensions/criteria.

From Table 6, an unweighted supermatrix of the T_D and T_C matrices can be made, which can be seen in Table 7 and Table 8. The unweighted supermatrices in Table 6 and Table 7 will also provide local weights for the dimensions and criteria via average results.

Local weights are pure dimensional weights from relationships between dimensions and criteria weights from relationships between criteria, there is no dependency between dimensions and criteria.

Table 7. Matrix W_D

	D1	D2	D3	D4	D5	Rataan
D1	0,188	0,189	0,187	0,194	0,208	0,193
D2	0,173	0,184	0,181	0,197	0,184	0,184
D3	0,159	0,172	0,178	0,173	0,170	0,170
D4	0,249	0,256	0,245	0,232	0,254	0,247
D5	0,231	0,199	0,208	0,203	0,185	0,205

Table 8. Matrix W_C

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	Rataan
C1	0,157	0,200	0,222	0,203	0,169	0,238	0,240	0,217	0,265	0,266	0,264	0,255	0,177	0,235	0,214	0,234	0,225	0,197	0,191	0,165	0,229	0,240	0,218
C2	0,297	0,158	0,311	0,312	0,234	0,235	0,227	0,246	0,221	0,243	0,255	0,244	0,228	0,239	0,248	0,242	0,236	0,263	0,261	0,271	0,257	0,239	0,248
C3	0,267	0,303	0,168	0,300	0,309	0,243	0,259	0,268	0,228	0,216	0,218	0,234	0,277	0,246	0,261	0,255	0,275	0,267	0,263	0,273	0,255	0,249	0,256
C4	0,280	0,339	0,299	0,185	0,288	0,284	0,274	0,269	0,286	0,275	0,263	0,267	0,318	0,280	0,278	0,269	0,265	0,274	0,285	0,291	0,259	0,272	0,277
C5	0,186	0,240	0,271	0,233	0,137	0,201	0,210	0,253	0,187	0,173	0,168	0,174	0,250	0,224	0,214	0,215	0,230	0,225	0,194	0,207	0,202	0,215	0,210
C6	0,287	0,246	0,235	0,244	0,241	0,171	0,319	0,289	0,290	0,292	0,273	0,297	0,252	0,267	0,261	0,264	0,259	0,249	0,260	0,254	0,278	0,271	0,264
C7	0,281	0,269	0,243	0,276	0,293	0,328	0,180	0,299	0,297	0,290	0,290	0,273	0,248	0,266	0,264	0,262	0,255	0,264	0,259	0,259	0,277	0,279	0,271
C8	0,246	0,245	0,251	0,247	0,329	0,300	0,291	0,159	0,226	0,245	0,269	0,256	0,249	0,243	0,262	0,259	0,256	0,262	0,286	0,280	0,244	0,235	0,256
C9	0,210	0,177	0,188	0,201	0,203	0,226	0,224	0,229	0,129	0,251	0,250	0,257	0,215	0,210	0,208	0,215	0,206	0,216	0,202	0,215	0,208	0,221	0,212
C10	0,227	0,212	0,183	0,192	0,189	0,227	0,215	0,193	0,218	0,123	0,228	0,227	0,208	0,204	0,190	0,209	0,185	0,189	0,217	0,209	0,203	0,215	0,203
C11	0,227	0,201	0,185	0,193	0,190	0,223	0,222	0,212	0,256	0,252	0,133	0,262	0,215	0,210	0,200	0,211	0,227	0,222	0,224	0,216	0,209	0,222	0,214
C12	0,201	0,177	0,184	0,190	0,167	0,196	0,201	0,190	0,251	0,238	0,236	0,117	0,205	0,193	0,193	0,180	0,176	0,169	0,175	0,182	0,169	0,182	0,190
C13	0,135	0,232	0,260	0,224	0,251	0,128	0,138	0,177	0,146	0,135	0,153	0,137	0,157	0,183	0,209	0,184	0,205	0,203	0,182	0,178	0,211	0,160	0,181
C14	0,243	0,234	0,223	0,234	0,202	0,250	0,235	0,227	0,252	0,259	0,248	0,247	0,235	0,168	0,247	0,245	0,250	0,246	0,231	0,243	0,240	0,247	0,237
C15	0,195	0,208	0,207	0,215	0,206	0,173	0,177	0,170	0,172	0,179	0,188	0,183	0,215	0,208	0,130	0,210	0,207	0,223	0,194	0,197	0,192	0,196	0,193
C16	0,267	0,243	0,238	0,243	0,253	0,263	0,253	0,239	0,282	0,275	0,261	0,277	0,267	0,275	0,261	0,184	0,284	0,269	0,262	0,258	0,255	0,260	0,258
C17	0,134	0,122	0,151	0,118	0,183	0,173	0,172	0,184	0,138	0,125	0,150	0,130	0,123	0,173	0,179	0,177	0,090	0,153	0,131	0,128	0,139	0,138	0,146
C18	0,160	0,192	0,182	0,189	0,156	0,141	0,164	0,180	0,156	0,162	0,154	0,163	0,159	0,177	0,183	0,184	0,170	0,108	0,183	0,174	0,173	0,160	0,167
C19	0,229	0,274	0,267	0,265	0,255	0,262	0,243	0,237	0,255	0,248	0,240	0,249	0,228	0,248	0,242	0,249	0,256	0,252	0,177	0,307	0,266	0,252	0,250
C20	0,245	0,276	0,272	0,274	0,251	0,248	0,248	0,239	0,247	0,250	0,246	0,260	0,239	0,254	0,261	0,256	0,243	0,260	0,305	0,167	0,279	0,250	0,253
C21	0,276	0,272	0,258	0,266	0,244	0,239	0,251	0,235	0,231	0,224	0,238	0,219	0,228	0,242	0,249	0,247	0,230	0,245	0,244	0,274	0,178	0,304	0,245
C22	0,249	0,178	0,203	0,195	0,250	0,251	0,258	0,290	0,267	0,278	0,275	0,272	0,305	0,256	0,248	0,248	0,272	0,242	0,273	0,252	0,276	0,194	0,252

From Table 7 and Table 8, a weighted supermatrix can be made. The results of the formation of a weighted supermatrix can be seen in Table 9. The final step is to construct a limit supermatrix from Table 8. The limit supermatrix will show the global weight for all criteria as shown in Table 10.

The results of the weighting of the criteria through the DEMATEL-Based ANP (DANP) process can be seen in Table 11.

Table 9. Matrix W^a

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22
C1	0,029	0,038	0,042	0,038	0,032	0,045	0,045	0,041	0,050	0,050	0,049	0,048	0,033	0,046	0,042	0,045	0,044	0,038	0,040	0,034	0,048	0,050
C2	0,056	0,030	0,058	0,059	0,044	0,044	0,043	0,047	0,041	0,046	0,048	0,046	0,043	0,046	0,048	0,047	0,046	0,051	0,054	0,056	0,053	0,050
C3	0,050	0,057	0,032	0,056	0,058	0,046	0,049	0,051	0,043	0,040	0,041	0,044	0,052	0,048	0,051	0,050	0,053	0,052	0,055	0,057	0,053	0,052
C4	0,053	0,064	0,056	0,035	0,054	0,054	0,052	0,051	0,054	0,051	0,049	0,050	0,060	0,054	0,054	0,052	0,051	0,053	0,059	0,061	0,054	0,057
C5	0,032	0,041	0,047	0,040	0,025	0,037	0,039	0,046	0,034	0,031	0,030	0,032	0,045	0,044	0,042	0,042	0,045	0,044	0,036	0,038	0,037	0,040
C6	0,050	0,043	0,041	0,042	0,044	0,031	0,059	0,053	0,052	0,053	0,050	0,054	0,046	0,053	0,051	0,052	0,051	0,049	0,048	0,047	0,051	0,050
C7	0,049	0,047	0,042	0,048	0,054	0,060	0,033	0,055	0,054	0,053	0,053	0,050	0,045	0,052	0,052	0,052	0,050	0,052	0,048	0,048	0,051	0,051
C8	0,043	0,042	0,043	0,043	0,061	0,055	0,053	0,029	0,041	0,044	0,049	0,046	0,045	0,048	0,052	0,051	0,050	0,052	0,053	0,052	0,045	0,043
C9	0,033	0,028	0,030	0,032	0,035	0,039	0,039	0,039	0,023	0,045	0,045	0,046	0,038	0,036	0,036	0,037	0,036	0,037	0,034	0,036	0,035	0,038
C10	0,036	0,034	0,029	0,030	0,033	0,039	0,037	0,033	0,039	0,022	0,041	0,040	0,037	0,035	0,033	0,036	0,032	0,033	0,037	0,036	0,034	0,037
C11	0,036	0,032	0,029	0,031	0,033	0,038	0,038	0,036	0,046	0,045	0,024	0,047	0,038	0,036	0,035	0,037	0,039	0,038	0,038	0,037	0,035	0,038
C12	0,032	0,028	0,029	0,030	0,029	0,034	0,035	0,033	0,045	0,043	0,042	0,021	0,037	0,033	0,033	0,031	0,030	0,029	0,030	0,031	0,029	0,031
C13	0,022	0,037	0,041	0,036	0,043	0,022	0,024	0,030	0,026	0,024	0,027	0,024	0,028	0,032	0,036	0,032	0,035	0,035	0,031	0,030	0,036	0,027
C14	0,061	0,058	0,055	0,058	0,052	0,064	0,060	0,058	0,062	0,063	0,061	0,061	0,058	0,039	0,057	0,057	0,058	0,057	0,059	0,062	0,061	0,063
C15	0,048	0,052	0,051	0,054	0,053	0,044	0,045	0,044	0,042	0,044	0,046	0,045	0,053	0,048	0,030	0,049	0,048	0,052	0,049	0,050	0,049	0,050
C16	0,066	0,060	0,059	0,061	0,065	0,067	0,065	0,061	0,069	0,067	0,064	0,068	0,066	0,064	0,061	0,043	0,066	0,063	0,066	0,065	0,065	0,066
C17	0,033	0,030	0,037	0,029	0,047	0,044	0,044	0,047	0,034	0,031	0,037	0,032	0,030	0,040	0,042	0,041	0,021	0,035	0,033	0,033	0,035	0,035
C18	0,040	0,048	0,045	0,047	0,040	0,036	0,042	0,046	0,038	0,040	0,038	0,040	0,039	0,041	0,043	0,043	0,040	0,025	0,046	0,044	0,044	0,041
C19	0,053	0,063	0,062	0,061	0,051	0,052	0,048	0,047	0,053	0,051	0,050	0,052	0,047	0,050	0,049	0,051	0,052	0,051	0,033	0,057	0,049	0,046
C20	0,057	0,064	0,063	0,064	0,050	0,049	0,050	0,048	0,051	0,052	0,051	0,054	0,050	0,052	0,053	0,052	0,049	0,053	0,056	0,031	0,052	0,046
C21	0,064	0,063	0,060	0,062	0,049	0,048	0,050	0,047	0,048	0,047	0,050	0,046	0,047	0,049	0,051	0,050	0,047	0,050	0,045	0,051	0,033	0,056
C22	0,058	0,041	0,047	0,045	0,050	0,050	0,051	0,058	0,056	0,058	0,057	0,057	0,063	0,052	0,050	0,050	0,055	0,049	0,050	0,046	0,051	0,036

Table 10. Limit Supermatrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22
C1	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042
C2	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048
C3	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050
C4	0,054	0,054	0,053	0,053	0,054	0,054	0,054	0,053	0,054	0,053	0,053	0,053	0,054	0,054	0,054	0,054	0,054	0,054	0,054	0,054	0,054	0,054
C5	0,039	0,039	0,039	0,039	0,039	0,039	0,039	0,039	0,039	0,039	0,039	0,039	0,039	0,039	0,039	0,039	0,039	0,039	0,039	0,039	0,039	0,039
C6	0,048	0,048	0,048	0,048	0,048	0,048	0,049	0,048	0,048	0,048	0,048	0,049	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048
C7	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050
C8	0,047	0,047	0,047	0,047	0,047	0,047	0,047	0,047	0,047	0,047	0,047	0,047	0,047	0,047	0,047	0,047	0,047	0,047	0,047	0,047	0,047	0,047
C9	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036
C10	0,035	0,035	0,035	0,035	0,035	0,035	0,035	0,035	0,035	0,035	0,035	0,035	0,035	0,035	0,035	0,035	0,035	0,035	0,035	0,035	0,035	0,035
C11	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036
C12	0,032	0,032	0,032	0,032	0,032	0,032	0,032	0,032	0,032	0,032	0,032	0,032	0,032	0,032	0,032	0,032	0,032	0,032	0,032	0,032	0,032	0,032
C13	0,031	0,031	0,031	0,031	0,031	0,031	0,031	0,031	0,031	0,031	0,031	0,031	0,031	0,031	0,031	0,031	0,031	0,031	0,031	0,031	0,031	0,031
C14	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058
C15	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048	0,048
C16	0,063	0,063	0,063	0,063	0,063	0,063	0,063	0,063	0,063	0,063	0,063	0,063	0,063	0,063	0,063	0,063	0,063	0,063	0,063	0,063	0,063	0,063
C17	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036	0,036
C18	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042
C19	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051
C20	0,052	0,052	0,052	0,052	0,052	0,052	0,052	0,052	0,052	0,052	0,052	0,052	0,052	0,052	0,052	0,052	0,052	0,052	0,052	0,052	0,052	0,052
C21	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051
C22	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051	0,051

Table 11. Dimensional Local Weight, Criteria Local Weight, And Global Weight

Dimension	Dimension Local Weight	Criteria	Criteria Local Weight	Global Weight
D1	0,193	C1	0,218	0,042
		C2	0,248	0,048
		C3	0,256	0,050
		C4	0,277	0,054
D2	0,184	C5	0,210	0,039
		C6	0,264	0,048
		C7	0,271	0,050
		C8	0,256	0,047
D3	0,170	C9	0,212	0,036
		C10	0,203	0,035
		C11	0,214	0,036
		C12	0,190	0,032
		C13	0,181	0,031
D4	0,247	C14	0,237	0,058
		C15	0,193	0,048
		C16	0,258	0,063
		C17	0,146	0,036
		C18	0,167	0,042
D5	0,205	C19	0,250	0,051
		C20	0,253	0,052
		C21	0,245	0,051
		C22	0,252	0,051

3.3. *Loyalty Program Assessment*

The assessment was carried out by three experts which derive from 1 of the 3 companies that participated in this research. The loyalty program assessment will be carried out to determine the suitability of the loyalty program being implemented with the criteria that have been designed through a questionnaire using a 5-likert scale, where 0 indicates "Strongly Disagree" and 5 indicates "Strongly Agree".

There are 5 loyalty programs that will be assessed by experts, including High-Value Customer (HVC), CX Commander, Apps, Calender of Events, and High-Speed Same Price. Each of the program will be evaluated by the experts.

The questionnaire will be processed using SAW with equations (7) - (9), where the rij value is obtained from the loyalty program assessment through a questionnaire and the wj comes from the global weight of the criteria based on DANP. The final value of each loyalty program can be seen in Table 12.

Table 12. Dimensional Local Weight, Criteria Local Weight, And Global Weight

Dimension	Criteria	P1	P2	P3	P4	P5
D1	C1	0,011	0,016	0,021	0,021	0,042
	C2	0,048	0,044	0,004	0,004	0,022
	C3	0,050	0,045	0,018	0,018	0,023
	C4	0,049	0,054	0,013	0,013	0,031
Score D1		0,158	0,158	0,057	0,106	0,118
D2	C5	0,035	0,035	0,039	0,030	0,022
	C6	0,009	0,007	0,009	0,048	0,005
	C7	0,039	0,039	0,050	0,039	0,028
	C8	0,039	0,047	0,047	0,043	0,039
Score D2		0,121	0,128	0,145	0,161	0,093
D3	C9	0,029	0,029	0,026	0,023	0,036
	C10	0,031	0,031	0,014	0,024	0,035
	C11	0,033	0,033	0,029	0,025	0,036
	C12	0,032	0,029	0,014	0,011	0,029
	C13	0,031	0,031	0,017	0,028	0,031
Score D3		0,157	0,153	0,101	0,111	0,167
D4	C14	0,047	0,042	0,047	0,042	0,058
	C15	0,048	0,044	0,036	0,040	0,044
	C16	0,051	0,051	0,051	0,046	0,063
	C17	0,036	0,033	0,036	0,024	0,024
	C18	0,042	0,042	0,037	0,029	0,033
Score D4		0,224	0,212	0,208	0,181	0,222
D5	C19	0,042	0,051	0,023	0,037	0,037
	C20	0,043	0,052	0,024	0,038	0,033
	C21	0,051	0,043	0,022	0,014	0,029
	C22	0,051	0,029	0,044	0,051	0,036
Score D5		0,186	0,176	0,112	0,141	0,136
Total Score		0,846	0,828	0,624	0,699	0,736
Ranking		1	2	5	4	3

4. Result and Discussion

4.1. *Network Relationship Map (NRM) Analysis*

Table 5 and Table 6 represent the T matrix for the dimensions and criteria for DEMATEL processing results. The T matrix for dimensions and criteria can be analyzed through equations (4) - (6) to form the NRM. The results of equations (4) - (6) can be seen in Table 13 and Table 14.

Table 13. The Sum of Influence Given and Received on Dimension

Dimension	r	c	r+c	r-c
Resource (D1)	0,417	0,359	0,776	0,059
Financial (D2)	0,364	0,341	0,705	0,024
Quality (D3)	0,351	0,315	0,666	0,035
Relationship (D4)	0,347	0,459	0,806	-0,112
Operational (D5)	0,377	0,382	0,760	-0,005

Table 14. The Sum of Influence Given and Received on Criteria

Dimension	Criteria	r	c	r+c	r-c
D1	C1	2,033	1,374	3,406	0,659
	C2	1,602	1,567	3,169	0,036
	C3	1,971	1,594	3,565	0,377
	C4	1,751	1,735	3,486	0,016
D2	C5	1,233	1,252	2,485	-0,018
	C6	1,801	1,579	3,381	0,222
	C7	2,047	1,615	3,662	0,432
	C8	1,367	1,531	2,898	-0,164
D3	C9	1,529	1,477	3,005	0,052
	C10	1,793	1,411	3,204	0,383
	C11	1,742	1,488	3,230	0,254
	C12	1,635	1,323	2,959	0,312
	C13	1,055	1,222	2,277	-0,166
D4	C14	1,716	2,372	4,089	-0,656
	C15	1,760	1,926	3,686	-0,166
	C16	1,566	2,579	4,145	-1,013
	C17	1,099	1,466	2,565	-0,367
	C18	1,501	1,675	3,175	-0,174
D5	C19	1,512	1,678	3,191	-0,166
	C20	1,575	1,700	3,276	-0,125
	C21	1,653	1,653	3,305	0,000
	C22	1,933	1,660	3,593	0,273

The value (r + d) indicates the priority level of the dimension/criteria and the value (r-d) indicates the level of influence of the dimension/criteria. NRM is generated through (r+d, r-d) as can be seen in Figure 2 dan 3.

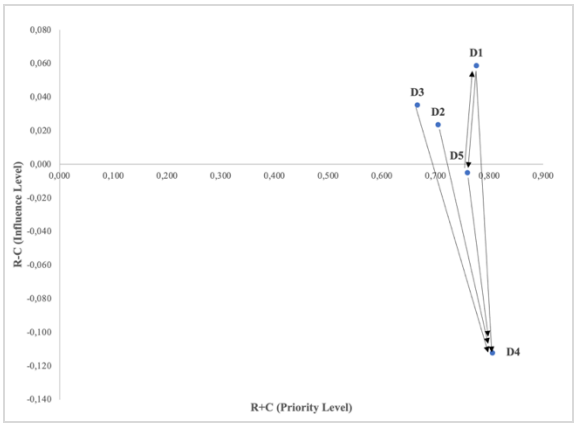
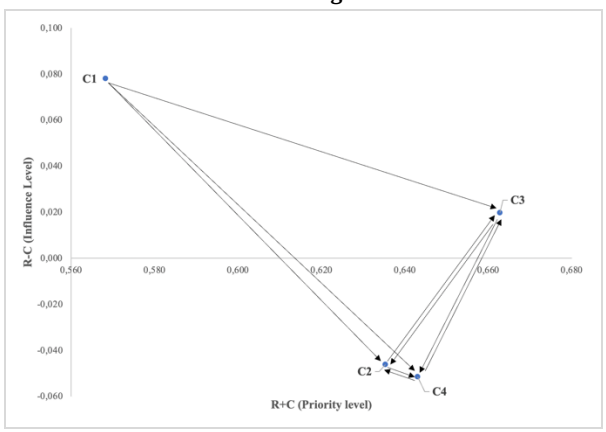
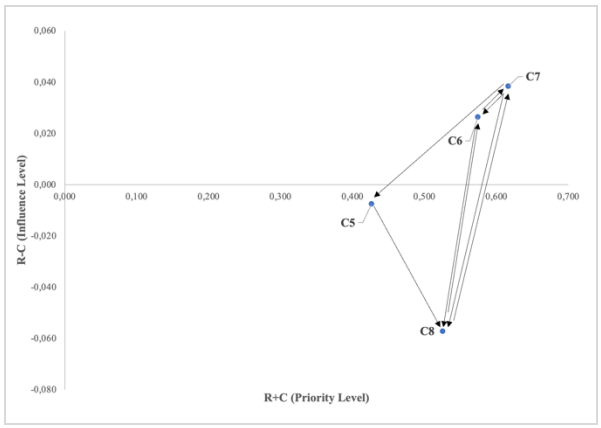


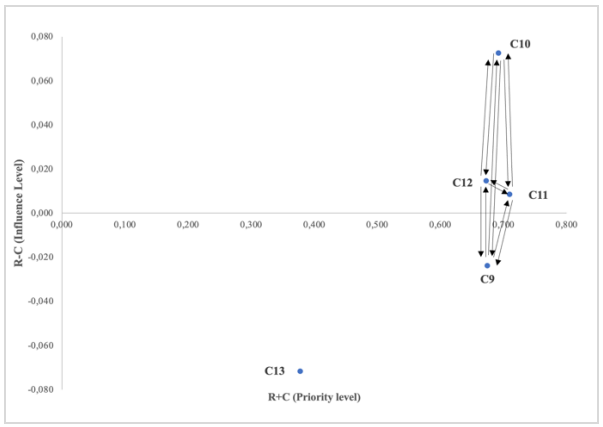
Figure 2. The Influential NRM of Relation within Dimensions



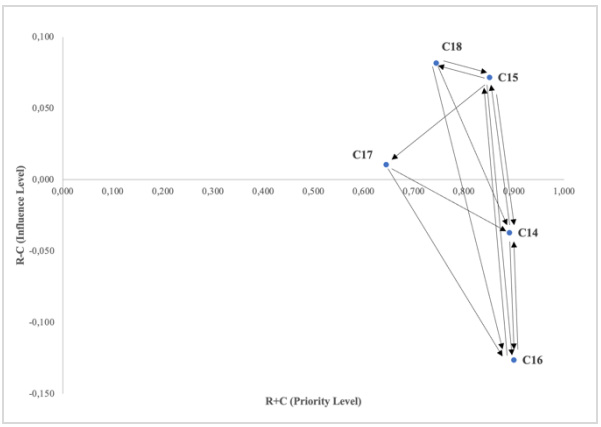
(a)



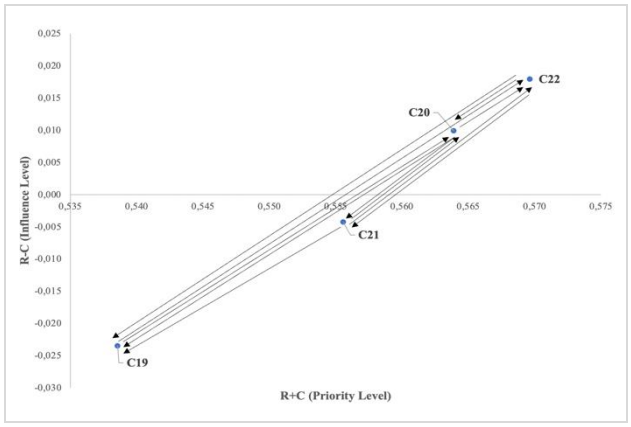
(b)



(c)



(d)



(e)

Figure 3. The Influential NRM of Criteria within Dimensions: (a) Resource (b) Financial (c) Quality (d) Relationship (e) Operational

NRM can show the level of priority of dimensions/criteria and the level of influence between dimensions/criteria, and the decision-making approach in evaluating the best loyalty program becomes clearer. Companies can determine loyalty program design strategies based on priority information and the impact of each dimension or criterion.

4.2. *Loyalty Program Assessment Analysis*

Following are the results of the loyalty program assessment using the Simple Additive Weighting (SAW) method, the best and worst loyalty programs for each dimension can be seen in Table 15.

Table 15. Loyalty Program's Assessment

Dimension	Program Loyalty				
	P1	**P2**	**P3**	**P4**	**P5**
Resource (D1)	0,158	0,158	0,057	0,106	0,118
Financial (D2)	0,121	0,128	0,145	0,161	0,093
Quality (D3)	0,157	0,153	0,101	0,111	0,167
Relationship (D4)	0,224	0,212	0,208	0,181	0,222
Operational (D5)	0,186	0,176	0,112	0,141	0,136

Loyalty Program Assessment Analysis of Resource Dimension

The highest loyalty program value for the resource dimension is the HVC (P1) & CX Commander (P2) loyalty program with a value of 0.158; while the loyalty program that has the lowest value is the customer application loyalty program (P3) with a value of 0.057.

HVC is a customer segmentation program, while CX Commander is a special resource assignment for HVC monitoring, so that the two programs can synergize with each other in meeting customer needs and achieving customer satisfaction. Meanwhile, improvements to customer application programs can start with improvements to each criterion in the resource dimension, such as adding features to the customer application, including the frontliner availability/tracking feature, so that customers can feel the benefits of the customer application which is able to solve their problems.

Loyalty Program Assessment Analysis of Financial Dimension

The highest loyalty program value for the financial dimension is the Calendar of Event (P4) loyalty program with a value of 0.161; while the loyalty program that has the lowest value is the High-Speed Same Price (P5) loyalty program with a value of 0.093.

CoE is a program that provides an overview of the activities that will be provided to both customers and potential customers, so financially the CoE program is not a program that only requires costs, but may also generate revenue. Meanwhile, improvements to the HSSP program can start with improvements to each criterion in the financial dimension such as improvements in packageization, so that in the future all internet packages not only have many choices but also ensure that each internet package issued does not overlap in providing benefits/prices.

Loyalty Program Assessment Analysis of Quality Dimension

The highest loyalty program value for the quality dimension is the High-Speed Same Price (P5) program with a value of 0.167; while the loyalty program that has the lowest value is the customer application loyalty program (P3) with a value of 0.101.

HSSP is a program that ensures the value received by customers is commensurate with the costs paid, so that the quality of this program really supports customer satisfaction, where changes in internet price standards which continue to decline can continue to be offset by the increase in quality obtained by existing customers.

Meanwhile, improvements to customer application programs can start with improvements to each criterion in the quality dimension such as additional features for measuring network quality around the user's location and additional features for providing notifications to customers when mass disruptions occur and schedules for service improvements that will be carried out, so that customers can obtain information so that customers can then take action to overcome these problems. This will make customers feel like they need or even depend on the customer's application.

Loyalty Program Assessment Analysis of Relationship Dimension

Overall, the value of the loyalty program in the relationship dimension does not have a significant difference, meaning that all loyalty programs have been able to fulfill all the criteria expected to support customer satisfaction. The highest loyalty program value for the relationship dimension is the HVC loyalty program (P1) with a value of 0.224; while the loyalty program that has the lowest value is the Calendar of Event (P4) loyalty program with a value of 0.181.

HVC is a customer segmentation program, so in terms of dimensions the relationship will definitely be very good because the program provided has been tailored to certain customer segments which will ultimately match customer expectations. Meanwhile, improvements to the CoE program can start with improvements to each criterion in the relationship dimension such as adding a variety of activities that attract more old customers, so that old customers will still feel luckier than new customers. This can support the smooth process of getting new customers, without causing customer churn.

Loyalty Program Assessment Analysis of Operational Dimension

The highest loyalty program value for the operational dimension is the HVC loyalty program (P1) with a value of 0.186; while the loyalty program that has the lowest value is the customer application loyalty program (P3) with a value of 0.112.

HVC is a customer segmentation program, which includes benefits for customers including monitoring operationalization during installation and future use, so this program has a big impact on the operational priority process that must be carried out in the field. Meanwhile, improvements to customer application

programs can start with improvements to each criterion in the operational dimension such as through feature improvements to simplify the process of registering new installations and live tracking of the process of installing new installations which can be accessed periodically by customers, so that customer complaints regarding the use of customer applications that are difficult to use and uninformative can be resolved.

5. Conclusion

The selection of 5 dimensions and 22 criteria for customer satisfaction in telecommunications operators for fixed broadband services, namely resources, finance, quality, relationships, and operations.

Based on the influence relationship between dimensions, the dimensions that most influence customer satisfaction in telecommunications operators with fixed broadband services are resource (0.059), quality (0.035), financial (0.024), and operational (-0.005); while the dimension most influenced by other dimensions is relativism (-0.112).

The criteria that are most influential and affected on each dimension in customer satisfaction at telecommunications operators with fixed broadband services respectively, namely:

a. Resource Dimensions: Internet Network Coverage (0.078) & Frontliner Capabilities (CSR, Technicians, etc.) (-0.052).
b. Financial Dimension: Available Internet Package Prices (0.038) & Regular Discounts or Promos (-0.057).
c. Quality Dimensions: Network Signal Quality (0.073) & Customer Data Security (-0.072)
d. Relationship Dimension: The company regularly provides information to customers (0.082) & customer recommendations to relatives (-0.126)
e. Operational Dimension: Product Development (0.018) & Timeliness in Dealing with Disruptions (-0.024).

The best loyalty program for fixed broadband service telecommunications operators (PT X) is High Value Customer (HVC), while the worst is Customer Application.

6. Recommendation

The results of this research have provided information regarding customer satisfaction criteria for telecommunications operators in the fixed broadband segment, but this research has not accommodated information from other segments. The development of the internet provider service segment is aimed at collaborating with the mobile & fixed broadband segments, where the mobile segment from 2017 to 2019 only reached +-0.5% annually (Laporan Keuangan 2016-2021), while data on the growth of telecommunications operators in the fixed broadband segment has continued to increase since 2018 (Press Search, 2022). Therefore, further research is needed on customer satisfaction criteria in the fixed mobile convergence segment so that companies can optimally control the telecommunications market share.

References

IGID. (2023). Pengguna Internet Indonesia Paling Banyak Usia Berapa? indonesia.go.id: https://www.indonesia.go.id/mediapublik/detail/2093#:~:text=Berdasarkan%20hasil%20survei%20Asosiasi%20Penyelenggara,orang%20pada%20periode%202022%2D2023.

Databoks. (2023). Penetrasi Internet Indonesia Peringkat ke-8 di ASEAN, Siapa Teratas? Diambil kembali dari databoks.katadata.co.id: https://databoks.katadata.co.id/datapublish/2023/09/06/penetrasi-internet-indonesia-peringkat-ke-8-di-asean-siapa-teratas

Databoks. (2021). Pengguna Internet Indonesia Peringkat ke-3 Terbanyak di Asia Diambil kembali dari databoks.katadata.co.id: https://databoks.katadata.co.id/datapublish/2021/10/14/pengguna- internet- indonesia-peringkat-ke-3-terbanyak-di-asia

Spire CI Report &Data Warehouse IndiHome. (2021). Pangsa Pasar Fixed Broadband di Indonesia Diambil Kembali dari dashboard.telkom.co.id: dashboard.telkom.co.id/cbd (Data Olahan)

PT Telkom Indonesia (Persero). (2021). Laporan Tahunan 2020 Diambil kembali dari www.telkom.co.id: https://www.telkom.co.id/data/lampiran/1619904911437_AR%20Telk om%20202 0%20INDO%20-%201%20Mei_web-compressed.pdf

Nonatero. (2022). Data Churn atas Permintaan Sendiri Periode Jan-Jun 2021 Diambil Kembali dari nonatero.telkom.co.id: http://nonatero.telkom.co.id/new/index.php?SkhVUE0zNWNTeXJKW i9PcXpZN lVSOElWbzFraGZtV21SNzB0cU4rTHFDakhjY0F4NDBJZU1oRWd6 SlMyMlJZ Sg==#

Gupta, S., & Lehmann, D. R. (2003). Customers as assets. Journal of Interactive Marketing

Buttle, F., & Maklan, S. (2015). Customer Relationship Management Concept and Technologies 3rd Edition. Elsevier Ltd.

Büyüközkan, G., & Güleryüz, S. (2016). An Integrated DEMATEL- ANP Approach for Renewable Energy Resources Selection in Turkey. International Journal Production Economics.

Mendoza, G. A., & Martins, H. (2006). Multi-criteria decision analysis in natural resource management: A critical review of methods and new modelling paradigm. Forest Ecology and Management.

Xi, X., & Qin, Q. (2013). Product quality evaluation system based on AHP fuzzy comprehensive evaluation. Journal of Industrial Engineering and Management, 6(1).

Hsu, C.-C., & Liou, J. J. (2013). An Outsourcing Provider Decision Model for the Airline Industry. Journal of Air Transport Management.

Belton, V. (1986). A comparison of the analytic hierarchy process and simple multi-attribute value function. European Journal of Operational Research.

Wang, P., Zhu, Z., & Wang, Y. (2016). A novel hybrid MCDM model combining de SAW, TOPSIS and GRA methods based on experimental design. Agration Sciences, 345, 27-45.

Laporan Keuangan. (2016-2021). Telkom/Telkomsel, Indosat, XL, dan Smartfren

Press Search. (2022). Total FBB Subscribers. Survey Report 2022.