ICIC 2018

ICIC 2018

Aryaduta Hotel, Palembang

17-18 October 2018

Palembang - Indonesia

The Third International Conference on Informatics and Computing

"Strengthening Nation Competitiveness through Intelligent Computing in the Current Digital Disruption Era"

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ICIC 2018

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Message from the General Chair

Our understanding of the shifts that disrupt businesses, industries, and sectors has profoundly improved over the past 30 years: We know far more about how to identify the shifts and what dangers their pose in the Disruption technology, although, there is still a need to better understand the nature of disruptions and their relationship to emerging technology. A disruptive technology displaces an established technology and shakes up the ground-breaking product and innovation that creates a completely new industry. "Emerging technology", "disruptive innovation", and "disruptive technology" have evolved as frequently used concepts in scientific literature on Science, Technology and Innovation. In many contexts, including academic and professional literature, the usage of these concepts may obfuscate their meaning to researchers and practitioners.

Considering these intelligent computing innovation and disruptive innovation, The 3rd International Conference on Informatics and Computing (ICIC 2018) has its theme as "Strengthening Nation Competitiveness through Intelligent Computing in the Current Digital Disruption Era. Our goal is to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results on all aspects of Informatics Engineering, Computing Science, Information Science, and Software Engineering, in relation to disruptive technology. The hot topics such as Artificial Intelligence, Internet of Thing, Blockchain, 5G using Massive MIMO, Wireless Sensor Network, e-Commerce, etc. will be discussed in 5 sessions and 6 parallel tracks of ICIC 2018.

The ICIC 2018 received a total of 312 submitted papers and each paper went through a thorough reviewing process to get at least three independent reviews. After a careful and rigorous selected process, we decided to accept 157 papers for the presentation in the main technical program. The acceptance rate of the paper for the conference was thus 50%. The paper presentations are organized into 30 sessions in total, on the 17-18 Oktober 2018. On top of the regular paper presentations, ICIC 2018 also features three keynote speeches delivered by internationally-renowned researchers: Dr. Gerard Borg from the Australian National University, Canberra, Australia, Dr. Thomas from Germany, and Prof. Dr. Zainal. A. Hasibuan from University of Indonesia, who is also the Chair of APTIKOM.

ICIC 2018 attract researchers from 15 countries as authors and reviewers. i.e. Australia, France, Germany, Greece, India, Indonesia, Japan, Malaysia, Morocco, Oman, Nigeria, Netherlands, Philippines, Saudi Arabia, Sweden. ICIC 2018 has received submission from 919 authors, and we also supported by 91 reviewers.

As a general chair, I cordially welcome all participants to ICIC 2018. We are blessed to have competent and dedicated organisers, so I would like to thanks to APTIKOM and Unviersity of Bina Darma as the host of ICIC 2018 and also to 12 co-hosts and co-sponsors from higher education institutions, i.e. Sampoerna University, STMIK Nusa Mandiri, Universitas BSI, Universitas Budi Luhur, STMIK Bina Insani, Universitas Dian Nuswantoro, STIKOM Bali, STMIK Dipanegara, Universitas Parahiyangan, STMIK Tasikmalaya, Universitas Pasundan.

In ICIC 2018, the participants can find new colleagues and new opportunity to make this conference as a fruitful conference. We trust that all participants will enjoy an intellectual and stimulating discussion during the conference that allow them to move forward in contributing their research work to the body of knowledge in Computer Engineering, Computing Science, Information Science, and Software Engineering.

Thank you.

Prof. Dr. Teddy Mantoro, SMIEEE

General Chair of ICIC-2018

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Keynotes

Strengthening Nation Competitiveness through Intelligent Computing in the Current Digital Disruption Era

Prof. Dr. Zainal A. Hasibuan

Professor of Computer Science, University of Indonesia

Chairman of Indonesian Association of Computing and Informatics Higher Education (APTIKOM)

Abstract

Life-time of technology become shorter and get outdated easily. What we learn and the way we learn change faster than ever. Despite internal and external barriers, such as poor management, logistics digital payment infrastructure and so forth, Indonesian e-business economy seems to be thriving. Current studies show that there are still a lot of opportunities for Indonesia to shift to digital economy without jeopardizing the existing ones. Stand-alone research is a past. Now research is moving towards research collaborations in multi-disciplinary. The use of intelligent computing in multi-disciplinary research produces industry 4.0 technologies that create disruption in our daily life. These disruptive knowledge and technology are driven by a big volume of data, variety of data, velocity of data, and veracity of data. The constraint on memory size, computing power, sampled data are no longer exist. The data volume collected based on continuous spatial and temporal is growing with an unthinkable speed and with a very high variety, although the validity is questionable. However with a sophisticated algorithm in data analytic, deep learning, and intelligent system, the research results show promising solutions to many problems and creates opportunities to improve nation competitiveness.

Globalization, Artificial Intelligence and Education

Dr. Thomas G&#65533;tz

Germany

Abstract

As a country and nation that is multi-ethnic, multi-religious, and multi-cultural, Indonesia continues to carry out dynamics in political, religious, social and cultural life. This dynamics is influenced by the process of globalization, religious change, cultural diversity and the implementation of political democracy. This talk will discuss the how the globalization is affected and supported by AI and education, and how it is going to influence a multi-cultural country like Indonesia.

Introduction to ANU-MIMO: a Wireless Network Infrastructure for Remote Populations

Dr. Gerard Borg - Australian National University College of Science

Abstract

ANU-MIMO is a scalable, distributed wireless MIMO network designed for decentralised deployment by a community. By leveraging existing back-haul, users can use ANU-MIMO to build a large-scale broadband wireless network. In this talk, we present the case for ANU-MIMO as a key enabler for the democratisation of the Internet infrastructure. We introduce its key technical ideas and present some case studies for Indonesia.

Dr Gerard Borg is a research scientist and senior lecturer in wireless and radiofrequency engineering at the Australian National University. He received a PhD in Physics from the University of Sydney. Over his career, he has worked in various fields including fusion plasma research, fundamental physics of plasma, rf-based diagnostics, Internet-of-Things and wireless. He is the inventor of the plasma antenna and various radiofrequency circuit compo-nents. His current areas of focus include fixed wireless access, radiofrequency tracking and distributed systems. Gerard is a strong advocate for the democratisation of the Internet infrastructure and has invented ANU-MIMO, a technology to deliver low cost license-free broadband to everyone.

PROGRAM SCHEDULE

16 October 2018	
13.00:18.00	Transfer from airport to main hotel and registration
17 October 2018	
07:30-08:15	Registration
08:15-09:15	**Opening session of the ICIC 2018***
08.15-08.22	Welcoming Remark by General Chair Prof. Dr. Teddy Mantoro
08.22-08.30	Remark from Aptikom Prof Dr. Zainal Hasibuan
08.30-08.40	Welcoming Remark from the Host-Rector UBD
08.40-08.55	Traditional Dance
08.55-09.05	Opening Remark by the Governor of South Sumatera or Mayor of Palembang
09.05-09.15	Official opening of the ICIC 2018 and Photo Session
09:15-09:30	*Coffee Break*
09:30-10:25	**Keynote Speech 1****
10:30-12:00	Technical Session 1 – TS1 (Parallel: 6 tracks)
12:00-13:05	*Lunch Break*
13:10-14:10	**Keynote Speech 2****
14:15-15:55	Technical Session 2 – TS2 (Parallel: 6 tracks)
15:55-16:15	*Coffee Break*
14:15-15:55	Technical Session 3 – TS3 (Parallel: 6 tracks)
18:10-19.00	*Break*
19.00-21.30	**Gala Dinner**

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18 October 2018	
07.15-08.55	Technical Session 4 – TS4 (Parallel: 6 tracks)
08.55-09.55	**Keynote Speech 3****
09.55-10.10	*Coffee Break*
10.10-11.30	Technical Session 5 – TS5 (Parallel: 6 tracks)
11.30-12.00	**Closing and Best papers announcement***
12.00-13.00	*Lunch and Disperse (Go to Munas Aptikom Opening)*

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Technical Session Schedule

Technical Session-1

Track 1

PaperID114	**Texture Feature Extraction Based On GLCM and DWT for Beef Tenderness Classification** Sigit Widiyanto, Sarifuddin Madenda, Eri Prasetyo Wibowo, Yuhara Sukra and Dini Tri Wardani
PaperID119	**Data Mining Classification of Intelligence Quotient in High School Students** Des Suryani, Ause Labellapansa, Setia Wulandari and Ahmad Hidayat
PaperID134	**Feature Extraction Using Histogram of Oriented Gradient and Hu Invariant Moment for Face Recognition** Eri Prasetyo Wibowo, Sandi Agung Harseno and Robby Kurniawan Harahap
PaperID148	**Deep Learning Long-Short Term Memory for Indonesian Speech Digit Recognition using LPC and MFCC Feature** Ericks Rachmat Swedia, Achmad Benny Mutiara, Muhammad Subali, Ernastuti

Track 2

PaperID280	**Educational Data Mining (EDM) as a Model For Students's Evaluation in Learning Environment** Nurul Hidayat, Retantyo Wardoyo and Azhari SN
PaperID289	**Critical Success Factors for Project Management Office: an Insight from Indonesia** Teguh Raharjo, Betty Purwandari, Riri Satria and Iis Solichah
PaperID293	**Webuse Usability Testing for Farmer and Farmer Group Data Collection System** Halim Budi Santoso, Rosa Delima and Wahyuni
PaperID296	**Comparison of Two Methods Between TOPSIS and MAUT In Determining BIDIKMISI Scholarship** Ramadiani, Heliza Rahmania Hatta, Nurlia Novita and Azainil
PaperID301	**Evaluation of User Engagement in E-learning Standardization and Conformity Assessment Using Subjective and Objective Measurement** Lintang Yuniar Banowosari and Komang Anom Budi Utama

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Track 3

PaperID236	**Integration of Region-based Open Data Using Semantic Web** A.A.Gede Yudhi Paramartha, Kadek Yota Ernanda Aryanto and Gede Rasben Dantes
PaperID173	**Cloud-based e-Business Framework for Small and Medium Enterprises: Literature Review** Ni Made Satvika Iswari, Harry B. Santoso, and Zainal A. Hasibuan
PaperID180	**Usability Evaluation and Development of a University Staff Website** Andre Valerian, Harry Budi Santoso, Gladhi Guarddin and Martin Schrepp
PaperID183	**The Ontology of SMEs's Form Application for Interoperability Systems** Masodah Wibisono, Aris Budi Setyawan, Dini Tri Wardani and Sigit Widiyanto

Track 4

PaperID213	**Comparative Evaluation of Object Tracking with Background Subtraction Methods** Dennis Aprilla Christie and Topan Sukma
PaperID225	**Peripapillary Atrophy Detection in Fundus Images Based on Sector With Scan Lines Approach** Anindita Septiarini, Agus Harjoko, Reza Pulungan and Retno Ekantini
PaperID227	**Drivers' visual search behaviour: Eye tracking analysis approach (Case study: on Ir. H. Juanda Street Depok)** Dian Kemala Putri, Mohammad Iqbal, Karmilasari and Kemal Ade Sekarwati
PaperID246	**The Generalized Learning Vector Quantization Model to Recognize Indonesian Sign Language (BISINDO)** Tri Handhika, Ilmiyati Sari, Revaldo Ilfestra Metzi Zen, Dewi Putrie Lestari and Murni
PaperID250	**Algorithm for Simple Sentence Identification in Bahasa Indonesia** Dina Anggraini, Achmad Benny Mutiara, Tb. Maulana Kusuma and Lily Wulandari

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Track 5

PaperID3	**Template Matching Algorithm For Noise Detection in Cargo Container** Doni Setio Pambudi, Ruktin Handayani and Lailatul Hidayah
PaperID22	**Genetic Algorithm Modification Of Mutation Operators In Max One Problem** Ummul Khair, Adidtya Perdana, Arief Budiman, Yuyun Dwi Lestari and Dody Hidayat
PaperID24	**Meme Opinion Categorization by Using Optical Character Recognition (OCR) and Naive Bayes Algorithm** Amalia Amalia, Amer Sharif, Fikri Haisar, Dani Gunawan and Benny B Nasution
PaperID79	**Improving Naïve Bayes in Sentiment Analysis For Hotel Industry in Indonesia** Tata Sutabri, Agung Suryatno, Dedi Setiadi and Edi Surya Negara
PaperID109	**Early Identification of Leaf Stain Disease in Sugar Cane Plants Using Speeded-Up Method Robust Features** Romi Fadillah Rahmat, Dani Gunawan, Sharfina Faza, Karina Ginting and Erna Budhiarti Nababan

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Track 6

Technical Session Schedule

Technical Session-2

Track 1

PaperID179	**Comparison of Color Constancy Approaches on Images with Unbalanced Color Distribution** Mona Satrio Siagian, Vega Valentine and Purnawarman Musa
PaperID203	**Real-time Recognition and Information Extraction on C++ Syntax with Augmented Reality** Jacquline Morlav S. Waworundeng, Andria Kusuma Wahyudi and Dwinanto Herlambang Mudjiono
PaperID243	**Performance Analysis of Big Data Frameworks on Virtualized Clusters** Amil Ahmad Ilham, Muhammad Niswar and Andi Muhammad Ryanto
PaperID244	**Fuzzy Kernel Robust Clustering for Anomaly based Intrusion Detection** Zuherman Rustam and Aini Suri Talita
PaperID247	**Segmentation of Overlapping Areas on Pap Smear Images with Color Features Using K-Means and Otsu Methods** Dwiza Riana, Herdian Tohir and Achmad Nizar Hidayanto

Track 2

PaperID223	**Hybrid CPU and GPU Computation to Detect Lung Nodule in Computed Tomography Images** I Wayan Budi Sentana, Naser Jawas and Anggun Esti Wardani
PaperID239	**Clustering Grey-Scale Face-Images Using Modified Adaptive Affinity Propagation with a New Modeled Preference** Rina Refianti, Achmad Benny Mutiara, Asep Juarna and Adang Suhendra
PaperID245	**Optimizing Marshall Test Parameters on Asphalt Concrete Using Hybrid Neural Network - Genetic Algorithm Approach** Achmad Baroqah Pohan, Tati Mardiana, Nining Suryani, Hilda Amalia, Yunita, Umi Fadillah, Rachmat Adi Purnama and Frengki Pernando
PaperID252	**An Initial Study to Solve Imbalance Sundanese Handwritten Dataset in Character Recognition** E. Paulus, M. Suryani, S.Hadi and Fadhliyah Natsir
PaperID254	**Classification of Personality Type By Typology Hippocrates - Galenus Using Naivebayes Algorithm and Naivebayes Decision Tree Algorithm** Rizky Firmanda and Desti Fitrianti

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Track 3

PaperID210 **An Adaptive e-Learning Model Based on Myers-Briggs Type Indicator (MBTI)**
Mesra Betty Yel, Sfenrianto Sfenrianto and Elisa Tri Meistiawan

PaperID241 **Determinant factors of new investor intention for using online trading system**
Fikri Pratama Afif, Putu Wuri Handayani and Ave Adriana Pinem

PaperID283 **Comparative Analysis of Multi-Criteria Decision Making for Student Degree Completion Time based on Entropy Weighted**
Masna Wati, Niken Novirasari, Edy Budiman and Haeruddin

PaperID302 **Global Software Development and Capability Maturity Model Integration: a Systematic Literature Review**
Anita Hidayati, Betty Purwandari, Eko K. Budiardjo, Iis Solichah

PaperID305 **Influence Blended Learning on Learning Result of Algorithm and Programming**
Anthony Anggrawan, Prof. Dr. Nurdin Ibrahim, M.Pd, Prof. Dr. Suyitno M, M.Pd and Christofer Satria,M.Sn., ACA

Track 4

PaperID45 **Filtering Impolite Words in Social Network Using Naïve Bayes Classifier**
Lusiana, Hijrah Gemini and Yoyon Efendi

PaperID49 **Comparing CART and C5.0 Algorithm Performance of Human Development Index**
Priati Assiroj, Harco Leslie Hendric Spits Warnars and Ahmad Fauzi

PaperID91 **The Modeling of Artificial Neural Network of Early Diagnosis for Malnutrition with Backpropagation Method**
Cynthia Hayat and Barens Abian

PaperID107 **Mel-frequency Cepstral Coefficient-Vector Quantization Implementation for Voice Detection of Rice-Eating Birds in The Rice Fields**
Romi Fadillah Rahmat, Tri Ramadhani, Dani Gunawan, Sharfina Faza and Rahmat Budiarto

PaperID162 **Students' Academic Performance Prediction using Data Mining**
Fergie Joanda Kaunang and Reymon Rotikan

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Track 5

PaperID171	**Comparison of Job Position Based Promotion Using: VIKOR, ELECTRE And Promethee Method** Akmaludin, Sulistianto SW, Adjat Sudrajat, Santoso Setiawan, Hendra Supendar, Yopi Handrianto, Rusdiansyaj and Tuslacia
PaperID226	**Symmetric Key Distribution Model Using RSA-CRT Method** Retyanto Wardoyo, Emy Setyaningsih and Anny Kartika Sari
PaperID271	**Identifying and Validating Components for National Cyber Security Framework** Farisya Setiadim Albaar Rubhasy and Zainal A Hasibuan
PaperID272	**Hybrid RC4 and Affine Ciphers to Secure Short Message Service on Android** Opim Salim Sitompul, Nurun Hawa Pasaribu, Handrizal and Erna Budhiarti Nababan
PaperID300	**Verification Authenticity Digital Documents of Certificate and Transcript Using Background Subtraction Method**

Track 6

PaperID268	**Analysis Similarity of Taekwondo Movement Using Data Motion** Dharmayanti, Mohammad Iqbal, Adang Suhendra and Achmad Benny Mutiara
PaperID270	**S-box Construction of Highly Strict Avalanche Criterion Using Algebraic Technique** Alamsyah, Agus Bejo and Teguh Bharata Adji
PaperID288	**Experiments on Character and Word Level Features for Text Classification Using Deep Neural Network** Muhammad Gumilang and Ayu Purwarianti
PaperID299	**Utilization of Semantic Web Rule Language for Tourism Ontology** Helna Wardhana, Khabib Mustofa and Anny Kartika Sari
PaperID304	**Neural Network with Support Vector Regression for Land-Use Growth Prediction** Herlawati, Rahmadya Trias Handayanto and Solikin

Technical Session Schedule

Technical Session-3

Track 1

PaperID65	**Quran Tajweed Extraction and Segmentation Based on HSV Color Space Models** Tjut Awaliyah Zuraiyah, Sarifuddin Madenda, Rina Noviana and Ravi A. Salim
PaperID73	**Digital Image Analysis of Beef Color Using Euclidean Distance Method** Hanny Hikmayanti Handayani and Deden Wahiddin
PaperID108	**Android-Based Text Recognition on Receipt Bill for Tax Sampling System** Romi Fadillah Rahmat, Dani Gunawan, Sharfina Faza, Novia Haloho and Erna Budhiarti Nababan
PaperID147	**Hardware Based Artificial Neural Networks for Basic Pattern Recognition Application** Sunny Arief Sudiro, Adi Putra Arianto, Linda Wahyu Widianti, Bheta Agus Wardijono and Ire Puspa Wardhani
PaperID256	**SPOT: A Low Cost Intelligent Parking System for Urban Malls** Akeem Olowalayemo, Ala Abdulsalam Alarood, Shee Niang Yap and Teddy Mantoro

Track 2

PaperID38	**Prediction the Crime Motorcycles of Theft using ARIMAX-TFM with Single Input** Azhari and Pradita Eko Prasetyo Utomo
PaperID112	**Steganography with Highly Random Linear Congruential Generator for Security Enhancement** Opim Salim Sitompul, Frainskoy Rio Naibaho, Zakarias Situmorang and Erna Budhiarti Nababan
PaperID136	**Expert Mapping Development System with Disease Searching Sympthom Based on ICD 10** Aries Muslim, Adang Suhendra, A. Benny Mutiara and Teddy Oswari
PaperID151	**Comparing SAW and AHP Decision Support Methods for Disease Analysis in Indonesia** Prihandoko, Ardiono Roma Nugraha, Mufni Alida, Muhammad Nizar Yoga Pratama and Dewi Agushinta R.

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Track 5

PaperID2	**Redesigning CHIML: Orchestration Language for Chimera-Framework** Go Frendi Gunawan, Jozua Ferjanus Palandi and Subari
PaperID139	**Performance Analysis of Information Quality Indexing in Government Agency's Social Media: a case of Customs in Indonesia** Noni Yuniana Putri Pamungkas, Achmad Nizar Hidayanto and Ika Chandra Hapsari
PaperID141	**Development of Banten E-Heritage using Virtual Reality Technology on Mobile Device** Muhammad Subali, Miftah Andriansyah, Debyo Saptono, Imam Purwanto, Antonius Irianto S, Hadi Rahmadi adn Linda Asri L. Sudjono
PaperID178	**Preprocessing For Crawler Of Short Message Social Media** Winda Widya Ariestya, Ida Astuti, and I Made Wiryana
PaperID237	**Toward Immersive Mobile Multimedia: From Mobile Video to Mobile Extended Reality** Hans-Jurgen Zepernick

Track 6

PaperID273	**Classification Default of Credit Card Clients Using LS-SVM Ensemble** Armin Lawi and Firman Aziz
PaperID274	**Classification for Multiformat Object of Cultural Heritage using Deep Learning** Ridwan Andi Kambau, Zainal Arifin Hasibuan and M. Octaviano Pratama
PaperID291	**Spellchecker Improvement on Stemmer Algorithm for Indonesian Language** Indira Ayawanodya and Arief Fatchul Huda
PaperID303	**Cluster Analysis of Indonesian Province Based on Prices of Several Basic Food Commodities** Dedy Sugiarto, Is Mardianto, Lukmanul Hakim, Anung A Ariwibowo and Muhammad Najih

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Technical Session Schedule

Technical Session-4

Track 1

PaperID216	**Primary Care Functional Requirements of a Health Information System in Indonesia** Sandra Hakiem Afrizal, Tris Eryando, Putu Wuri Handayani and Arief Sartono
PaperID269	**Bioinformatics Resource Portal** Edy Budiman, Nocinati Puspitasari, Sitti Nur Alam, Mohammad Aldrin Akbar, Haeruddin and Fasa Alameka
PaperID286	**Group Decision Support System to Selection Tourism Object in Bali Using Analytic Hierarchy Process (AHP) and Copeland Score Model** Putu Sugiartawan and Sri Hartati
PaperID312	**The Digital Company Based on Competitive Strategy** Nina Kurnia Hikmawati and Doni Purnama Alamsyah

Track 2

PaperID259	**Mobile Measurement System of Ozone Concentration in Urban Areas** Suryono Suryono and Ainie Khuriati
PaperID249	**A Review: Contrast-Limited Adaptive Histogram Equalization (CLAHE) methods to help the application of face recognition** Purnawarman Musa, Farid Al Rafi and Missa Lamsani
PaperID166	**Genetic Algorithms with Variable Length Chromosomes for High Constraint Problems in Spatial Data** Rahmadya Trias Handayanto, Nitin Kumar Tripathi, Sumanta Guha and Herlawati
PaperID195	**Heading Correction in Rocket Flight System using Odometry Trajectory Information** Hadyan Mardhi Fadlillah, Purnawarman Musa and Dinda Desita Wimananda

Track 4

PaperID156 **Review of the Recent Research on Automatic Text Summarization in Bahasa Indonesia**
Dani Gunawan and Amalia Amalia

PaperID164 **Saving The Vegetable Peddler (Mlijo) with Information Technology**
Putri Elfa Mas'udia, Mochammad Sarosa, Amalia Eka Rakhmania, Usman Zulhijah and Emma Shofia Putri

PaperID189 **Automatic Time-based Learning Type Analysis towards Dynamic Personalization**
Kusuma Ayu Laksitowening, Harry Budi Santoso and Zainal A. Hasibuan

PaperID193 **Automatic Comparison of Products based on Opinion Features using Synonym and Jaccard Similarity**
Agus Zainal Arifin, Dinial Utami Nurul Qomariah, Muhammad Riduwan, Addien Haniefardy, Yufis Azhar, Rizka Wakhidatus Sholikah and Dini Adni Navastara

Track 5

PaperID229 **The AlKesFar App, A Mobile Augmented Reality on Learning Media Tools for Indonesian Pharmacy School**
Muhamad Firdaus, Mastuki and Johanes Flady Allan

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Comparison of Job Position Based Promotion Using: VIKOR, ELECTRE And Promethee Method

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Abstract - The long-term prospect of the company's progress is determined by the quality of human resources (HR), The urgency to maintain the company's survival it takes a reliable and futuristic leader. Measuring tool that can be used is none other than the performance of human resources. Of course with potential leaders will provide the vision of the company's mission to grow and expand. Leadership selection process can be done with promotion positions based on performance preference. The purpose of this research is to conduct selection of performance promotion based on performance using Multi-Criteria Decision Making (MCDM) selection methods such as Analytic Hiererachy Process (AHP), VIKOR, ELECTRE, and Promethee, in addition to proving the result of a number of methods based on MCDM such as AHP for the determination of preferences data design, while for data analysis using three methods that will be compared the results of VIKOR, ELECTREE and Promethee. The measurable performance bases for promotional positions are viewed from Intelegency (IG), Panning (PL), Depandebility (DP), Reaction Behavior (RB), Failed Jobs (FJ), Quantity of Work (QW), and Knowledge of Job (KJ). The results obtained provide an interpretation that the promethee method is closer to the actual results, while the vikor method is almost close to the results of truth and far away when compared with the electre method. Thus, it can be concluded that the best method for placing employee positions is promethee method.

Keyword - Multi-criteria, Preferences of Job Performance, Elimination Method, ELECTRE, VIKOR, Promethee.

I. INTRODUCTION

The quality of human resources is paramount to the progress of the company, because individualized expertise can be measured from individual performance [1], this is a very important thing as a benchmark in selecting a potential leader through the promotion process. Promotion of positions is an effort that must be done by the company to provide an opportunity for employees who have job performance to occupy a position higher than the occupation previously occupied and have greater authority and responsibility [1].

The purpose of this study is to compare the results of several methods to provide the best solution for achieving the objectives of the company and to compare the results of the promotion by using three methods, namely VIKOR, ELECTRE, and Promethee, how decisions are generated using the three methods . The three methods used to achieve performance appraisal goals, of course, require employees who have good performance appraisals that can work effectively and efficiently [2]. Good performance is just as an employee is able to demonstrate work behavior that leads to the achievement of company intent and purpose [2]. For that the company did many ways to improve employee performance including promotion of position for improvement of employee position, one of them using method Analytic Hierarchy Process (AHP) [3]. This research tries to perform a combination of methods to perform new solutions to the promotion process. The combination is a crystallization of Multi-Criteria Decision Making (MCDM) ie AHP and VIKOR, ELECTRE, and Promethee. Each method has its own function that can be collaborated to determine the final snap with the indexed result method with VIKOR. VIKOR can also be used for selecting personnel training [4] in addition to MCDM.

MCDM is one way used to analyze the criteria and tools alternative comparison depicted in the hierarchy of analysis on AHP. The MCDM method applied by means of iteration to obtain the eigenvector value and the result will be used to determine the preference of the criteria used in this discussion. MCDM is also included in the decision-making category by ranking [5]. Analytic Hierarchy Process (AHP) is a method for evaluating and selecting that simplifies complex problems

simple by composing each level, the level being the goal, criteria, and alternative [6], [7], [8]. VIKOR became a widely-used collaboration with MCDM [9], Vikor is a ranking method that uses the index system to determine the best alternative [10], and other multi-criteria of ELECTRE and Promethee.

The performance appraisal used for promotion consists of seven criteria, each criterion has a special understanding in giving an assessment, there are variables that have the greatest value with the best value meaning (High is the Best) and there is a small value variable that implies the best value (Low is the Best). [10]. The Compromise Ranking method, also known as the VIKOR, ELECTRE, and Promethee methods gives an alternative ranking and determines the solution called the most ideal compromise. In fact, this work considers few alternatives for simplicity, but this model can be used to evaluate more alternatives. Its main task is to compare a number of alternatives and choose the best [11].

II. METHOD

Employee job preferences in companies that are not mentioned determine the progress of the company, so that it requires a number of appropriate criteria to choose the best leader, this assessment is determined by company policy which is determined to be seven assessment criteria, by seeing competition outside these criteria to be a company decision to remain a company who is able to lead the market.

The collecting data, a leader has done a number of samples from employees with seven criteria that have been set and have been done by experts to give value to a number of employees. This has been done for several periods, then the average value of each employee is taken.

In this section describes the concept of Position Promotion, Analytic Hierarchy Process (AHP), Multi-Criteria Decision Making (MCDM) analysis, and the elimination process using VIKOR, ELECTREE, and Promethe methods.

2.1. Promotion of Position.

Promotion of position should be done with a number of assessment criteria, each criterion can be seen from some skills interests, which is the total of the results that can be accountable. While performance in work performance is the result of work in quality and quantity achieved by an employee in performing its duties according to the responsibility given to him [3], [12], [13].

The criteria used for promotion include seven criteria: (1) intelligence (IG); (2) Planning (PL); (3) Dependability (DP); (4) Reaction Behavior (RB); (5) Failed Jobs (FJ); (6) Quantity of Work (QW); (7) Knowledge of Job (KJ). Each criterion has two special rating categories, rating with High Is The Best (HB) meaning that the highest score is the best value or Low is The Best (LB) the lowest value is the best. For category of HB criteria are PL, QW, and KJ, while those belonging to LB criteria category are IG, DP, RB, and FJ. Each preference gives unequal meanings in its usage, the amount of preference can be interpreted as the best MAX value or it can be interpreted that the MIN value is the best.

2.2. Analytic Hierarchy Process (AHP).

The current multi-criteria decision-making method (MCDM) presents a valid alternative to weighting multiple criteria while enabling the participation of multiple stakeholders. Among them, the Analytical Hierarchy Process (AHP) makes decisions in a way that is easily understood by stakeholders and allows them to analyze independent sub-problems by constructing problems in hierarchy and using pairwise comparisons [14]. The specificity of the AHP has an appropriate allocation in pairwise comparisons across the entire range of human activities, AHP [15], capable of handling both qualitative and quantitative problems [16] that apply to decomposed hierarchical modeling to facilitate solving complex problems [17] or variables in a hierarchical order, assigns numerical values to subjective considerations of the importance of each variable and synthesizes these considerations to determine which variables have the highest priority [2], [18].

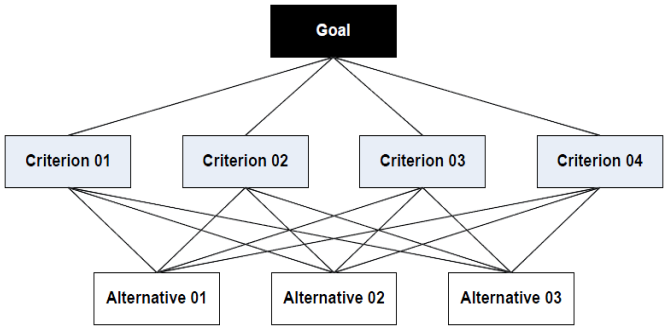

Fig. 1. Hierarchy for all level [19].

In this process AHP has a very important role to determine the value of the importance of each criterion as a preference measured based on the value of its importance in the form of a hierarchical model. Then arranged in pairwise matrix form.

2.3. Multi-Criteria Decision Making (MCDM).

Metode MCDM merupakan metode yang yang berbeda dan telah dibandingkan sebagian besar berdasarkan metode penyelesaian, algoritma, dan metode tertimbang [20].

The MCDM method is a different method and has been compared largely based on settlement methods, algorithms, and weighted methods [20].

Techniques such as MCDM that are multi-criteria are considered as one of the best ways and means to think and equate the level of some criteria for decision-making and deal with imprecision [21].

The MCDM method has proven to be widely used and has its own advantages in decision making which are the development of AHP [5], [10], [22], [23], [24]. MCDM is able to provide comparisons that generate rankings from each level of both criteria and alternatives. In this study the priority values generated from MCDM are used for preferences with multi-criteria VIKOR, ELECTREE, and Promethee. Some of the criteria of the VIKOR decision-making method are based as a combined function that represents the proximity to the ideal, derived from the compromise programming method. The linear normalization used by VIKOR to eliminate the unit

of criterion function [5], thus the baseline data as the reference for determining the largest value and the smallest value as the range for determining the magnitude of normalization which is continuously operated with preferences obtained by AHP and MCDM methods, through the optimal eigenvector value of each criterion, note (Table 1 and Table 2).

TABLE I. CRITERIA PAIRWISE MATRIX [25]

$$\begin{bmatrix} 1 & a_{12} & & a_{1n} \\ a_{21} & \dots & a_{ij} & \dots \\ \dots & a_{ji}=1/a_{ij} & \dots & \dots \\ a_{n1} & \dots & \dots & 1 \end{bmatrix}$$

Where ai, j is the comparison between element i and j of the lower triangular matrix containing reciprocal mean [17], [25]. The role of MCDM in this case is to determine the value of each preferences that can be compared with AHP, while observation data is processed by VIKOR, ELECTRE, and Promehtee method. The end result of the criteria was obtained from instrumentation in the form of questionnaires by using MCDM with a number of iterations to obtain the optimal value of eigenvector, which then made the standard as the weight preference of the seven criteria used in this study.

2.4. VIKOR.

The VIKOR Method (Vise Kriterijumska Optimizacija I Kompromisno Resenje) is a method used for multi-criteria decision making [26].

The VIKOR method is performed to calculate the positive and negative ideal solution ratios [27] which provides a list of alternative ratings with the highest rating of VIKOR which is the result closest to the ideal solution. A number of equation have been simplified as VIKOR calculations such as

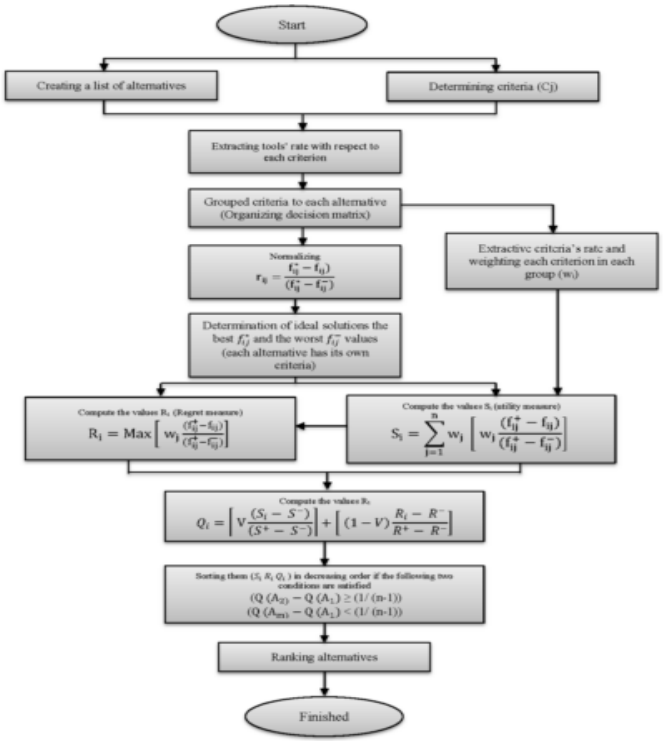

Fig. 2.The VIKOR Stage [8]

determining the Normalization of a matrix listed in (equation-1), which is used to determine the exact location of the sample R (i, j) of the specified range.

$$R_{ij} = \frac{(X*j - Xij)}{(X*j - X'j)} \quad (1)$$

Rij: Normalization Matrix VIKOR,
Xij: The value of the sample data i criteria j,
X*j: The Largest Value in one criteria,
X'j: The Smallest Value in one criterion,
i: The assessed employee (K1 ... K5),
j: Criteria used (seven criteria).

After the sample R (i, j) is normalized, then the weight of the Wj criterion is multiplied by R (i, j) summed into Si shown in (equation-2) and Ri represents the largest value of each row i seen in (equation-3).

$$S_i = \sum_{j=1}^{n} wj \; x \; (Rij) \quad (2)$$

$$Ri = \text{Max}_j[w_j \text{ x } R_{ij}] \quad (3)$$

After knowing the weight of each row, the dimensions of Si, and S* the largest value of S, S 'the smallest value of S, R* the largest variable R value and R' the smallest variable R value, of all, can be done determination of the VIKOR Qi index, with the equation seen in (equation-4).

$$Q_i = \left[\frac{Si - S'}{S* - S'}\right] \text{ x } v + \left[\frac{Ri - R'}{R* - R}\right] \text{ x } (1\text{-}v) \quad (4)$$

2.5. ELECTRE

The ELECTRE method is a concept of elimination from a normalized result through a function which is further downgraded to concordance and discordance to rank. The ELECTRE method has a basic understanding of the same data as a VICOR that has been normalized before with the rules The largest value is the best value or the smallest value is the best value.

Some steps must be taken to use the ELECTRE method seen in (Fig.3), MCDM combination poured into AHP and is a simplified way to be understood. Some of the equation used

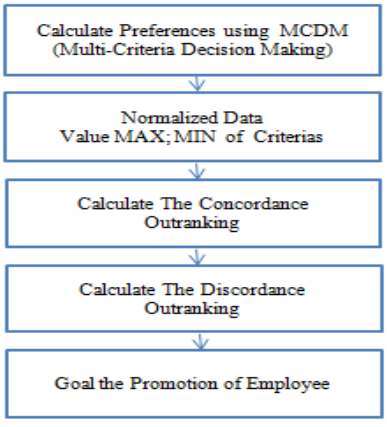

Fig. 3. Steph by Steph ELECTRE Method

in the ELECTRE method come from to search for data normalization using (equation-5).

$$R_{ij} = \frac{(Xij - X'j)}{(X*j - X'j)} \quad (5)$$

Where, Rij : Matrix Normalization,
Xij : The Searching Number,
X*j: Biggest Number,
X'j : Lowest Number,
i : Assessed Employee (K1…K5)
, j : Seven Criteria's.

While to find the value of concordance can use (equation-6), whereas to find the amount of discordance can use (equation -7). The equation used should still pay attention to the value of MAX and MIN values of each preference set.

$$C(i,i') = \sum_j wj \,, where \;\; R_{i,j} > R_{i',j} \quad (6)$$

$$D(i,i') = \sum_j wj \,, where \;\; R_{i,j} < R_{i',j} \quad (7)$$

So the end result can be searched by mathematical deduction of concordance and discordance resulting in a ranking of alternatives that can be decided.

2.6. Promethee.

Stages that must be known in Promethee there are some steph [28] namely:

Steph 1: Determination of deviations base on pairwise comparison.
Steph 2: Application of the preference function.
Steph 3: Calculation of an overall or global preference index.
Steph 4: Calculation of outranking flows the promethee-1 partial ranking (leaving flow dan entering flow).
Steph 5: Calculation of outranking flows the promethee-2 as complete ranking.

Promethee has a similar calculation process with ELECTRE, in terms of determining the magnitude of the matrix normalization, see (equation-8) to determine the normalization of the matrix. Other equation that can be used to analyze with the Promethee method in terms of aggregate determination of preference functions see (equation-9), leaving flow see (equation-10), entering flow see (equation-11) which is a partially separate outcome. To combine it using the net flow view see (equation-12).

$$R_{ij} = \frac{(Xij - X'j)}{(X*j - X'j)} \quad (8)$$

$$\pi(i,i') = [\sum_{j=1}^{m} wj \; x \; Pj\,(i,i')] \,/\, \sum_{j=1}^{m} wj \quad (9)$$

$$\Phi^{+}(i) = \frac{1}{(n-1)} \sum_{i'=1}^{n} \pi(i,i') \quad (10)$$

$$\Phi^{-}(i) = \frac{1}{(n-1)} \sum_{i'=1}^{n} \pi(i,i') \quad (11)$$

$$\Phi(i) = \Phi^{+}(i) - \Phi^{-}(i) \quad (12)$$

III. Implementation And Results

The making of hierarchy is a total picture of the research that creates the concept of modeling solutions. The hierarchy is used as a basic understanding model consisting of three levels: (1) the level of goal, which is the main target of employee performance performances for promotion of positions in an agency; (2) criterion level, is a barometer to measure the number of criteria determined by the value as a preference of each criterion. The preference quantity is obtained based on the hierarchical model which is processed iteratively until there is no difference to the eigenvector value, the use of this eigenvector value is the optimum value and will be used as the reference for the multiplication of the criteria with the result of normalization in multi-criteria calculation using VIKOR, ELECTRE , and Promethee.

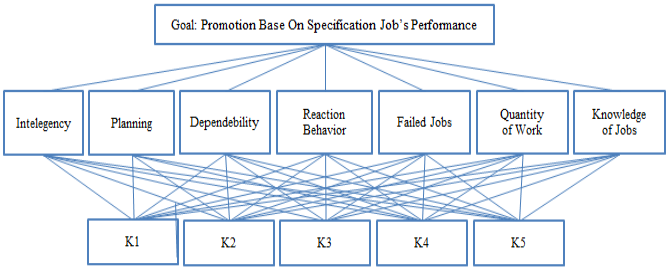

Fig. 3. Hierarchy of Position Based Promotion Model.

Multi-Criteria with AHP, used to determine the preference for the magnitude of each criterion, known under the optimal eigenvector and obtained through the iteration stage in the absence of the difference with the previous eigenvector, is the importance of the eigevector value [29]. For the value of criterion preferences, note (TABLE II).

TABLE II. Value Of Criteria Preference

Criteria	IG	PL	DP	RB	FJ	QW	KJ
Value	0.23	0.16	0.19	0.15	0.07	0.11	0.09

In the (TABLE II) illustrates the preferences of the seven criteria that serve as the basis for the interest of observations through the MCDM-AHP method and serve as a benchmark for the calculation process with the three methods VIKOR, ELECTRE, and Promethee.

TABLE III. Observation Data VIKOR, Electre, and Promethee

	IT	PL	DP	RB	FJ	QW	KJ
K1	74.05	64.67	73.94	**84.33**	14.02	**18.59**	**9.63**
K2	86.03	**94.23**	84.23	73.25	**13.45**	**97.81**	15.04
K3	66.73	83.18	**94.67**	48.85	**27.84**	30.59	27.66
K4	**99.50**	**60.75**	75.22	64.84	15.92	22.43	**99.52**
K5	**43.18**	76.35	**62.45**	**56.52**	16.58	61.77	45.27

The data shown in (TABLE III) is the data that becomes the basis of promotion research positions that will be compared with three methods namely VIKOR, ELECTRE, and Promethee, from five employees (K1-K5) for job position base promotion. The data must be specified first MAX value and MIN value, (note the number that is thickened) that made the process of normalization parameters.

3.1. VIKOR Method.

The first stage of the VIKOR method is to determine the normalization matrix, see (TABLE IV).

TABLE IV. NORMALIZATION WITH VIKOR.

	LB	HB	LB	LB	LB	HB	HB
	IG	PL	DP	RB	FJ	QW	KJ
K1	0.55	0.88	0.36	1.00	0.04	1.00	1.00
K2	0.76	0.00	0.68	0.69	0.00	0.00	0.94
K3	0.42	0.33	1.00	0.00	1.00	0.85	0.80
K4	1.00	1.00	0.40	0.45	0.17	0.95	0.00
K5	0.00	0.53	0.00	0.22	0.22	0.45	0.60

With the result data normalized through VIKOR, then determine the value of Si that can be done with the equation that existed in (equation -2) with the calculation results can be seen in (TABLE V).

TABLE V. MULTIPLICATION QUALITY AND NORMALIZATION.

BOBOT	0.24	0.15	0.18	0.16	0.06	0.10	0.11
	IG	PL	DP	RB	FJ	QW	KJ
K1	0.132	0.132	0.064	**0.160**	0.002	0.100	0.110
K2	**0.183**	0.000	0.122	0.110	0.000	0.000	0.103
K3	0.100	0.050	**0.180**	0.000	0.060	0.085	0.088
K4	**0.240**	0.150	0.071	0.072	0.010	0.095	0.000
K5	0.000	0.080	0.000	0.035	0.013	0.045	**0.066**

The next step determines the magnitude of each of the Si and Ri values. To obtain the value of Si can use (equation-2), whereas to determine the value of Ri can use the equation in (equation -3). The result of the value of Si and Ri values can be seen in (TABLE VI).

TABLE VI. VALUE OF Si and Ri

Alternative	Si	Ri
K1	0.70	0.16
K2	0.52	0.18
K3	0.56	0.18
K4	0.64	0.24
K5	0.24	0.07

At (TABLE VI) is the accompaniment of each of the Si and Ri values which in turn determine the VIKOR index to determine the ranking of selected alternatives. The results of the VIKOR index can determine the synthesize of the ranking of some alternatives, see (TABLE VII).

TABLE VII. QUANTITY OF Q VALUE AND RANG VIKOR

Alternatives	S	R	Q	Ranking
K1	**0.70**	0.160	0.77	4
K2	0.52	0.183	0.64	2
K3	0.56	0.180	0.68	3
K4	0.64	**0.24**	0.93	5
K5	**0.24**	**0.07**	0.00	1

3.2. ELECTRE Method.

With reference to (TABLE III), the ELECTRE method can calculate Concordance and Discordance by using a comparison of criteria functions, note (TABLE VIII). Thus, the value of Concordance and Discordance can be simplified, see (TABLE IX).

TABLE VIII. CONCORDANCE AND DISCORDANCE CRITERIAN FUNCTION.

	Weight	IG	PL	DP	RB	FJ	QW	KJ
	Fungtion	0.24	0.15	0.18	0.16	0.06	0.1	0.11
K1	C(1,2)	0.21	0.00	0.32	0.00	0.00	0.00	0.00
	C(1,3)	0.00	0.00	0.64	0.00	0.96	0.00	0.00
	C(1,4)	0.45	0.12	0.04	0.00	0.13	0.00	0.00
	C(1,5)	0.00	0.00	0.00	0.00	0.18	0.00	0.00
K2	C(2,1)	0.00	0.88	0.00	0.31	0.04	1.00	0.06
	C(2,3)	0.00	0.33	0.32	0.00	1.00	0.85	0.00
	C(2,4)	0.24	1.00	-0.28	0.00	0.17	0.95	0.00
	C(2,5)	0.00	0.53	0.00	0.00	0.22	0.45	0.00
K3	C(3,1)	0.13	0.55	0.00	1.00	0.00	0.15	0.20
	C(3,2)	0.34	0.00	0.00	0.69	0.00	0.00	0.14
	C(3,4)	0.58	0.67	0.00	0.45	0.00	0.10	0.00
	C(3,5)	0.00	0.00	0.00	0.22	0.00	0.00	0.00
K4	C(4,1)	0.00	0.00	0.00	0.55	0.00	0.05	1.00
	C(4,2)	0.00	0.00	0.00	0.24	0.00	0.00	0.94
	C(4,3)	0.00	0.00	0.60	0.00	0.83	0.00	0.80
	C(4,5)	0.00	0.00	0.00	0.00	0.05	0.00	0.60
K5	C(5,1)	0.55	0.35	0.36	0.78	0.00	0.55	0.40
	C(5,2)	0.76	0.00	0.68	0.47	0.00	0.00	0.34
	C(5,3)	0.42	-0.20	1.00	0.00	0.78	0.39	0.20
	C(5,4)	1.00	0.47	0.40	0.23	0.00	0.50	0.00

TABLE IX. CONCORDANCE AND DISCORDANCE

	K1	K2	K3	K4	K5
K1		0.42	0.24	0.63	0.06
K2	0.53		0.49	0.73	0.31
K3	0.76	0.54		0.65	0.16
K4	0.37	0.27	0.35		0.17
K5	0.94	0.69	0.84	0.83	

Note (TABLE IX), the value of the concordance is the value of the upper triangle, while the discordance value in the lower triangle will be obtained by determining the ranking of the ELECTRE method, see (TABLE X).

TABLE X. ALTERNATIVE RANKING ELECTRE

Employee	Concordance	Discordance	C-D	Ranking
K1	1.35	2.60	-1.25	4
K2	2.06	1.92	0.14	3
K3	2.11	1.92	0.19	2
K4	1.16	2.84	-1.68	5
K5	3.30	0.70	2.60	1

3.3. Promethee Method.

With reference to (TABLE III) which is an observation table, the processed data using the promethee method will assign aggregate preference functions first, note (TABLE XI).

TABLE XI. AGGREGATE Promethee PREFERENCES FUNCTION

	K1	K2	K3	K4	K5
K1		0.110	0.189	0.139	0.012
K2	0.306		0.278	0.332	0.151
K3	0.303	0.195		0.320	0.032
K4	0.178	0.120	0.245		0.058
K5	0.463	0.404	0.402	0.470	

The end result of the promethee, determined from the Leaving Flow and the Entering Flow that is still partial, so combined with the mathematical process to rank, take note (TABLE XII).

TABLE XII. PROMENTHEE RANKING

Alt	Leaving Flow	Entering Flow	C-D	Ranking
K1	0.113	0.312	-0.200	5
K2	0.267	0.207	0.059	2
K3	0.213	0.278	-0.066	3
K4	0.150	0.315	-0.165	4
K5	0.435	0.063	0.371	1

Comparison Results Promotion based performance performance using three methods of VIKOR, ELECTRE, and Promethee can be seen in (TABLE XIII).

TABLE XIII. RANGKING OF VIKOR, ELECTRE, and PROMETHEE.

Alternatives	Promotion Base Position		
	VIKOR	ELECTRE	Promethee
K1	0.770	-1.250	-0.200
K2	0.636	0.140	0.059
K3	0.678	0.190	-0.066
K4	0.933	-1.680	-0.165
K5	0.000	2.600	0.371
Ranking	5-2-3-1-4	5-3-2-1-4	5-2-3-4-1

The results obtained provide an interpretation that the promethee method is closer to the actual results, while the vikor method is almost close to the results of truth and far away when compared with the electre method. Thus, it can be concluded that the best method for placing employee positions is the promethee method.

IV. CONCLUSION

The conclusions that can be drawn from Job Promotion for performance-based employees appear to be varied, with the VIKOR method in sequential first rank K5-K2-K3-K1-K4. with the weight in sequence is 0.0; 0.636; 0.678; 0.77, and 0.93. While the results of ranking with the method of ELECTREE in sequence is K5-K3-K2-K1-K4, with consecutive weights 2.6; 0.19; 0.14; -1.25; and -1.68. And the result of ranking with Promethee method in sequence is K5-K2-K3-K4-K1, with consecutive weights 0.371; 0.059; -0.066; -0.165, and -0.2. The results obtained provide an interpretation that the promethee method is closer to the actual results, while the vikor method is almost close to the results of truth and far away when compared with the electre method. Thus, it can be concluded that the best method for placing employee positions is the promethee method.

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Comparison of Job Position Based Promotion Using: VIKOR, ELECTRE And Promethee Method

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Abstract - The long-term prospect of the company's progress is determined by the quality of human resources (HR), The urgency to maintain the company's survival it takes a reliable and futuristic leader. Measuring tool that can be used is none other than the performance of human resources. Of course with potential leaders will provide the vision of the company's mission to grow and expand. Leadership selection process can be done with promotion positions based on performance preference. The purpose of this research is to conduct selection of performance promotion based on performance using Multi-Criteria Decision Making (MCDM) selection methods such as Analytic Hiererachy Process (AHP), VIKOR, ELECTRE, and Promethee, in addition to proving the result of a number of methods based on MCDM such as AHP for the determination of preferences data design, while for data analysis using three methods that will be compared the results of VIKOR, ELECTREE and Promethee. The measurable performance bases for promotional positions are viewed from Intelegency (IG), Panning (PL), Depandebility (DP), Reaction Behavior (RB), Failed Jobs (FJ), Quantity of Work (QW), and Knowledge of Job (KJ). The results obtained provide an interpretation that the promethee method is closer to the actual results, while the vikor method is almost close to the results of truth and far away when compared with the electre method. Thus, it can be concluded that the best method for placing employee positions is promethee method.

Keyword - Multi-criteria, Preferences of Job Performance, Elimination Method, ELECTRE, VIKOR, Promethee.

I. INTRODUCTION

The quality of human resources is paramount to the progress of the company, because individualized expertise can be measured from individual performance [1], this is a very important thing as a benchmark in selecting a potential leader through the promotion process. Promotion of positions is an effort that must be done by the company to provide an opportunity for employees who have job performance to occupy a position higher than the occupation previously occupied and have greater authority and responsibility [1].

The purpose of this study is to compare the results of several methods to provide the best solution for achieving the objectives of the company and to compare the results of the promotion by using three methods, namely VIKOR, ELECTRE, and Promethee, how decisions are generated using the three methods . The three methods used to achieve performance appraisal goals, of course, require employees who have good performance appraisals that can work effectively and efficiently [2]. Good performance is just as an employee is able to demonstrate work behavior that leads to the achievement of company intent and purpose [2]. For that the company did many ways to improve employee performance including promotion of position for improvement of employee position, one of them using method Analytic Hierarchy Process (AHP) [3]. This research tries to perform a combination of methods to perform new solutions to the promotion process. The combination is a crystallization of Multi-Criteria Decision Making (MCDM) ie AHP and VIKOR, ELECTRE, and Promethee. Each method has its own function that can be collaborated to determine the final snap with the indexed result method with VIKOR. VIKOR can also be used for selecting personnel training [4] in addition to MCDM.

MCDM is one way used to analyze the criteria and tools alternative comparison depicted in the hierarchy of analysis on AHP. The MCDM method applied by means of calculation to obtain the eigenvector value and the result will be used to determine the preference of the criteria used in this discussion. MCDM is also included in the decision-making category by ranking [5]. Analytic Hierarchy Process (AHP) is a method for evaluating and selecting that simplifies complex problems

simple by composing each level, the level being the goal, criteria, and alternative [6], [7], [8]. VIKOR became a widely-used collaboration with MCDM [9], Vikor is a ranking method that uses the index system to determine the best alternative [10], and other multi-criteria of ELECTRE and Promethee.

The performance appraisal used for promotion consists of seven criteria, each criterion has a special understanding in giving an assessment, there are variables that have the greatest value with the best value meaning (High is the Best) and there is a small value variable that implies the best value (Low is the Best). [10]. The Compromise Ranking method, also known as the VIKOR, ELECTRE, and Promethee methods gives an alternative ranking and determines the solution called the most ideal compromise. In fact, this work considers few alternatives for simplicity, but this model can be used to evaluate more alternatives. Its main task is to compare a number of alternatives and choose the best [11].

II. Method

Employee job preferences in companies that are not mentioned determine the progress of the company, so that it requires a number of appropriate criteria to choose the best leader, this assessment is determined by company policy which is determined to be seven assessment criteria, by seeing competition outside these criteria to be a company decision to remain a company who is able to lead the market.

The collecting data, a leader has done a number of samples from employees with seven criteria that have been set and have been done by experts to give value to a number of employees. This has been done for several periods, then the average value of each employee is taken.

In this section describes the concept of Position Promotion, Analytic Hierarchy Process (AHP), Multi-Criteria Decision Making (MCDM) analysis, and the elimination process using VIKOR, ELECTREE, and Promethe methods.

2.1. Promotion of Position.

Promotion of position should be done with a number of assessment criteria, each criterion can be seen from some skills interests, which is the total of the results that can be accountable. While performance in work performance is the result of work in quality and quantity achieved by an employee in performing its duties according to the responsibility given to him [3], [12], [13].

The criteria used for promotion include seven criteria: (1) intelligence (IG); (2) Planning (PL); (3) Dependability (DP); (4) Reaction Behavior (RB); (5) Failed Jobs (FJ); (6) Quantity of Work (QW); (7) Knowledge of Job (KJ). Each criterion has two special rating categories, rating with High Is The Best (HB) meaning that the highest score is the best value or Low is The Best (LB) the lowest value is the best. For category of HB criteria are PL, QW, and KJ, while those belonging to LB criteria category are IG, DP, RB, and FJ. Each preference gives unequal meanings in its usage, the amount of preference can be interpreted as the best MAX value or it can be interpreted that the MIN value is the best.

2.2. Analytic Hierarchy Process (AHP).

The current multi-criteria decision-making method (MCDM) presents a valid alternative to weighting multiple criteria while enabling the participation of multiple stakeholders. Among them, the Analytical Hierarchy Process (AHP) makes decisions in a way that is easily understood by stakeholders and allows them to analyze independent sub-problems by constructing problems in hierarchy and using pairwise comparisons [14]. The specificity of the AHP has an appropriate allocation in pairwise comparisons across the entire range of human activities, AHP [15], capable of handling both qualitative and quantitative problems [16] that apply to decomposed hierarchical modeling to facilitate solving complex problems [17] or variables in a hierarchical order, assigns numerical values to subjective considerations of the importance of each variable and synthesizes these considerations to determine which variables have the highest priority [2], [18].

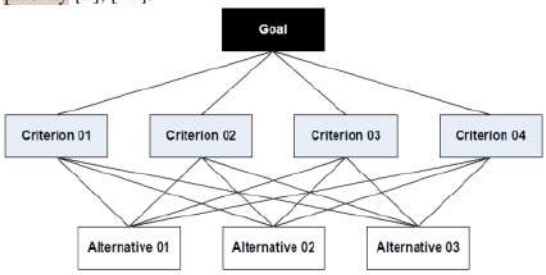

Fig. 1. Hierarchy for all level [19].

In this process AHP has a very important role to determine the value of the importance of each criterion as a preference measured based on the value of its importance in the form of a hierarchical model. Then arranged in pairwise matrix form.

2.3. Multi-Criteria Decision Making (MCDM).

Metode MCDM merupakan metode yang yang berbeda dan telah dibandingkan sebagian besar berdasarkan metode penyelesaian, algoritma, dan metode tertimbang [20].

The MCDM method is a different method and has been compared largely based on settlement methods, algorithms, and weighted methods [20].

Techniques such as MCDM that are multi-criteria are considered as one of the best ways and means to think and equate the level of some criteria for decision-making and deal with imprecision [21].

The MCDM method has proven to be widely used and has its own advantages in decision making which are the development of AHP [5], [10], [22], [23], [24]. MCDM is able to provide comparisons that generate rankings from each level of both criteria and alternatives. In this study the priority values generated from MCDM are used for preferences with multi-criteria VIKOR, ELECTREE, and Promethee. Some of the criteria of the VIKOR decision-making method are based as a combined function represents the proximity to the ideal, derived from the compromise programming method. The linear normalization used by VIKOR to eliminate the unit

of criterion function [5], the baseline data as the reference for determining the largest value and the smallest value as the range for determining the magnitude of normalization which is continuously operated with preferences obtained by AHP and MCDM methods, through the optimal eigenvector value of each criterion, note (Table 1 and Table 2).

TABLE I. CRITERIA PAIRWISE MATRIX [25]

$$\begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ a_{21} & \cdots & a_{ij} & \cdots \\ \cdots & a_{ji}=1/a_{ij} & \cdots & \cdots \\ a_{n1} & \cdots & \cdots & 1 \end{bmatrix}$$

Where ai, j is the comparison between element i and j of the lower triangular matrix containing reciprocal mean [17], [25]. The role of MCDM in this case is to determine the value of each preferences that can be compared with AHP, while observation data is processed by VIKOR, ELECTRE, and Promehtee method. The end result of the criteria was obtained from instrumentation in the form of questionnaires by using MCDM with a number of iterations to obtain the optimal value of eigenvector, which then made the standard as the weight preference of the seven criteria used in this study.

2.4. VIKOR.

The VIKOR Method (VIKOR Kriterijumska Optimizacija I Kompromisno Resenje) is a method used for multi-criteria decision making [26].

The VIKOR method is performed to calculate the positive and negative ideal solution ratios [27] which provides a list of alternative ratings with the highest rating of VIKOR which is the result closest to the ideal solution. A number of equation have been simplified as VIKOR calculations such as

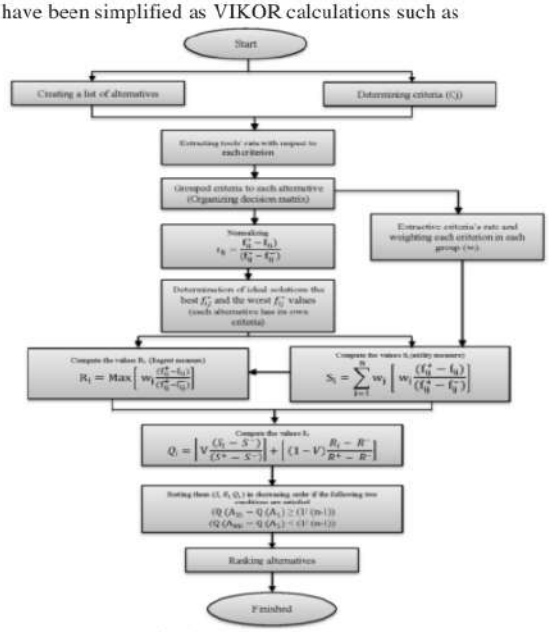

Fig. 2.The VIKOR Stage [8]

determining the Normalization of a matrix listed in (equation-1), which is used to determine the exact location of the sample R (i, j) of the specified range.

$$R_{ij} = \frac{(X*j - Xij)}{(X*j - X'j)} \quad (1)$$

Rij: Normalization Matrix VIKOR,
Xij: The value of the sample data i criteria j,
X*j: The Largest Value in one criteria,
X'j: The Smallest Value in one criterion,
i: The assessed employee (K1 ... K5),
j: Criteria used (seven criteria).

After the sample R (i, j) is normalized, then the weight of the Wj criterion is multiplied by R (i, j) summed into Si shown in (equation-2) and Ri represents the largest value of each row i seen in (equation-3).

$$S_i = \sum_{j=1}^{n} wj \; x \; (Rij) \quad (2)$$

$$Ri = \text{Max}_j[w_j \text{ x } R_{ij}] \quad (3)$$

After knowing the weight of each row, the dimensions of Si, and S* the largest value of S, S 'the smallest value of S, R* the largest variable R value and R' the smallest variable R value, of all, can be done determination of the VIKOR Qi index, with the equation seen in (equation-4).

$$Q_i = [\frac{Si - S'}{S* - S'}] \text{ x } v + [\frac{Ri - R'}{R* - R}] \text{ x } (1\text{-}v) \quad (4)$$

2.5. ELECTRE

The ELECTRE method is a concept of elimination from a normalized result through a function which is further downgraded to concordance and discordance to rank. The ELECTRE method has a basic understanding of the same data as a VICOR that has been normalized before with the rules The largest value is the best value or the smallest value is the best value.

Some steps must be taken to use the ELECTRE method seen in (Fig.3), MCDM combination poured into AHP and is a simplified way to be understood. Some of the equation used

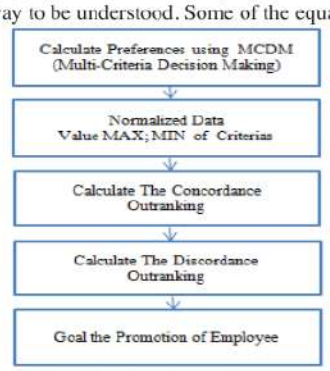

Fig. 3. Steph by Steph ELECTRE Method

in the ELECTRE method come from to search for data normalization using (equation-5).

$$R_{ij} = \frac{(Xij - X'j)}{(X*j - X'j)} \quad (5)$$

Where, Rij : Matrix Normalization,
Xij : The Searching Number,
X*j: Biggest Number,
X'j : Lowest Number,
i : Assessed Employee (K1…K5)
, j : Seven Criteria's.

While to find the value of concordance can use (equation-6), whereas to find the amount of discordance can use (equation -7). The equation used should still pay attention to the value of MAX and MIN values of each preference set.

$$C(i,i') = \sum_j wj, where\ R_{i,j} > R_{i',j} \quad (6)$$

$$D(i,i') = \sum_j wj, where\ R_{i,j} < R_{i',j} \quad (7)$$

So the end result can be searched by mathematical deduction of concordance and discordance resulting in a ranking of alternatives that can be decided.

2.6. Promethee.

Stages that must be known in Promethee there are some steph [28] namely:

Steph 1: Determination of deviations base on pairwise comparison.
Steph 2: Application of the preference function.
Steph 3: Calculation of an overall or global preference index.
Steph 4: Calculation of ranking flows the promethee-1 partial ranking (leaving flow dan entering flow).
Steph 5: Calculation of outranking flows the promethee-2 as complete ranking.

Promethee has a similar calculation process with ELECTRE, in terms of determining the magnitude of the matrix normalization, see (equation-8) to determine the normalization of the matrix. Other equation that can be used to analyze with the Promethee method in terms of aggregate determination of preference functions see (equation-9), leaving flow see (equation-10), entering flow see (equation-11) which is a partially separate outcome. To combine it using the net flow view see (equation-12).

$$R_{ij} = \frac{(Xij - X'j)}{(X*j - X'j)} \quad (8)$$

$$\pi(i,i') = [\sum_{j=1}^{m} wj \times Pj(i,i')] / \sum_{j=1}^{m} wj \quad (9)$$

$$\Phi^{+}(i) = \frac{1}{(n-1)} \sum_{i'=1}^{n} \pi(i,i') \quad (10)$$

$$\Phi^{-}(i) = \frac{1}{(n-1)} \sum_{i'=1}^{n} \pi(i,i') \quad (11)$$

$$\Phi(i) = \Phi^{+}(i) - \Phi^{-}(i) \quad (12)$$

III. Implementation And Results

The making of hierarchy is a total picture of the research that creates the concept of modeling solutions. The hierarchy is used as a basic understanding model consisting of three levels: (1) the level of goal, which is the main target of employee performance performances for promotion of positions in an agency; (2) criterion level, is a barometer to measure the number of criteria determined by the value as a preference of each criterion. The preference quantity is obtained based on the hierarchical model which is processed iteratively until there is no difference to the eigenvector value, the use of this eigenvector value is the optimum value and will be used as the reference for the multiplication of the criteria with the result of normalization in multi-criteria calculation using VIKOR, ELECTRE , and Promethee.

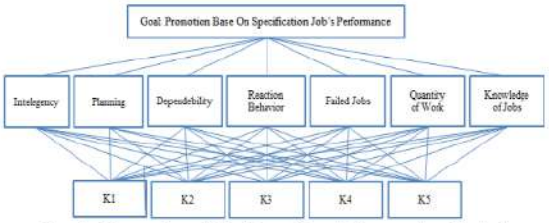

Fig. 3. Hierarchy of Position Based Promotion Model.

Multi-Criteria with AHP, used to determine the preference for the magnitude of each criterion, known under the optimal eigenvector and obtained through the iteration stage in the absence of the difference with the previous eigenvector, is the importance of the eigevector value [29]. For the value of criterion preferences, note (TABLE II).

TABLE II. Value Of Criteria Preference

Criteria	IG	PL	DP	RB	FJ	QW	KJ
Value	0.23	0.16	0.19	0.15	0.07	0.11	0.09

In the (TABLE II) illustrates the preferences of the seven criteria that serve as the basis for the interest of observations through the MCDM-AHP method and serve as a benchmark for the calculation process with the three methods VIKOR, ELECTRE, and Promethee.

TABLE III. Observation Data VIKOR, Electre, and Promethee

	IT	PL	DP	RB	FJ	QW	KJ
K1	74.05	64.67	73.94	**84.33**	14.02	**18.59**	**9.63**
K2	86.03	**94.23**	84.23	73.25	**13.45**	**97.81**	15.04
K3	66.73	83.18	**94.67**	48.85	**27.84**	30.59	27.66
K4	**99.50**	**60.75**	75.22	64.84	15.92	22.43	**99.52**
K5	**43.18**	76.35	**62.45**	**56.52**	16.58	61.77	45.27

The data shown in (TABLE III) is the data that becomes the basis of promotion research positions that will be compared with three methods namely VIKOR, ELECTRE, and Promethee, from five employees (K1-K5) for job position base promotion. The data must be specified first MAX value and MIN value, (note the number that is thickened) that made the process of normalization parameters.

3.1. VIKOR Method

The first stage of the VIKOR method is to determine the normalization matrix, see (TABLE IV).

TABLE IV. NORMALIZATION WITH VIKOR.

	LB	HB	LB	LB	LB	HB	HB
	IG	PL	DP	RB	FJ	QW	KJ
K1	0.55	0.88	0.36	1.00	0.04	1.00	1.00
K2	0.76	0.00	0.68	0.69	0.00	0.00	0.94
K3	0.42	0.33	1.00	0.00	1.00	0.85	0.80
K4	1.00	1.00	0.40	0.45	0.17	0.95	0.00
K5	0.00	0.53	0.00	0.22	0.22	0.45	0.60

With the result data normalized through VIKOR, then determine the value of Si th can be done with the equation that existed in (equation -2) with the calculation results can be seen in (TABLE V).

TABLE V. MULTIPLICATION QUALITY AND NORMALIZATION.

BOBOT	0.24	0.15	0.18	0.16	0.06	0.10	0.11
	IG	PL	DP	RB	FJ	QW	KJ
K1	0.132	0.132	0.064	**0.160**	0.002	0.100	0.110
K2	**0.183**	0.000	0.122	0.110	0.000	0.000	0.103
K3	0.100	0.050	**0.180**	0.000	0.060	0.085	0.088
K4	**0.240**	0.150	0.071	0.072	0.010	0.095	0.000
K5	0.000	0.080	0.000	0.035	0.013	0.045	**0.066**

The next step determines the magnitude of each of the Si and Ri values. To obtain the value of Si can use (equation-2), whereas to determine the value of Ri can use the equation in (equation -3). The result of the value of Si and Ri values can be seen in (TABLE VI).

TABLE VI. VALUE OF Si and Ri

Alternative	Si	Ri
K1	0.70	0.16
K2	0.52	0.18
K3	0.56	0.18
K4	0.64	0.24
K5	0.24	0.07

At (TABLE VI) is the accompaniment of each of the Si a Ri values which in turn determine the VIKOR index to determine the ranking of selected alternatives. The results of the VIKOR index can determine the synthesize of the ranking of some alternatives, see (TABLE VII).

TABLE VII. QUANTITY OF Q VALUE AND RANG VIKOR

Alternatives	S	R	Q	Ranking
K1	**0.70**	0.160	0.77	4
K2	0.52	0.183	0.64	2
K3	0.56	0.180	0.68	3
K4	0.64	**0.24**	0.93	5
K5	**0.24**	**0.07**	0.00	1

3.2. ELECTRE Method.

With reference to (TABLE III), the ELECTRE method can calculate Concordance and Discordance by using a comparison of criteria functions, note (TABLE VIII). Thus, the value of Concordance and Discordance can be simplified, see (TABLE IX).

TABLE VIII. CONCORDANCE AND DISCORDANCE CRITERIAN FUNCTION.

	Weight	IG	PL	DP	RB	FJ	QW	KJ
	Fungtion	0.24	0.15	0.18	0.16	0.06	0.1	0.11
K1	C(1,2)	0.21	0.00	0.32	0.00	0.00	0.00	0.00
	C(1,3)	0.00	0.00	0.64	0.00	0.96	0.00	0.00
	C(1,4)	0.45	0.12	0.04	0.00	0.13	0.00	0.00
	C(1,5)	0.00	0.00	0.00	0.00	0.18	0.00	0.00
K2	C(2,1)	0.00	0.88	0.00	0.31	0.04	1.00	0.06
	C(2,3)	0.00	0.33	0.32	0.00	1.00	0.85	0.00
	C(2,4)	0.24	1.00	-0.28	0.00	0.17	0.95	0.00
	C(2,5)	0.00	0.53	0.00	0.00	0.22	0.45	0.00
K3	C(3,1)	0.13	0.55	0.00	1.00	0.00	0.15	0.20
	C(3,2)	0.34	0.00	0.00	0.69	0.00	0.00	0.14
	C(3,4)	0.58	0.67	0.00	0.45	0.00	0.10	0.00
	C(3,5)	0.00	0.00	0.00	0.22	0.00	0.00	0.00
K4	C(4,1)	0.00	0.00	0.00	0.55	0.00	0.05	1.00
	C(4,2)	0.00	0.00	0.00	0.24	0.00	0.00	0.94
	C(4,3)	0.00	0.00	0.60	0.00	0.83	0.00	0.80
	C(4,5)	0.00	0.00	0.00	0.00	0.05	0.00	0.60
K5	C(5,1)	0.55	0.35	0.36	0.78	0.00	0.55	0.40
	C(5,2)	0.76	0.00	0.68	0.47	0.00	0.00	0.34
	C(5,3)	0.42	-0.20	1.00	0.00	0.78	0.39	0.20
	C(5,4)	1.00	0.47	0.40	0.23	0.00	0.50	0.00

TABLE IX. CONCORDANCE AND DISCORDANCE

	K1	K2	K3	K4	K5
K1		0.42	0.24	0.63	0.06
K2	0.53		0.49	0.73	0.31
K3	0.76	0.54		0.65	0.16
K4	0.37	0.27	0.35		0.17
K5	0.94	0.69	0.84	0.83	

Note (TABLE IX), the value of the concordance is the value of the upper triangle, while the discordance value in the lower triangle will be obtained by determining the ranking of the ELECTRE method, see (TABLE X).

TABLE X. ALTERNATIVE RANKING ELECTRE

Employee	Concordance	Discordance	C-D	Ranking
K1	1.35	2.60	-1.25	4
K2	2.06	1.92	0.14	3
K3	2.11	1.92	0.19	2
K4	1.16	2.84	-1.68	5
K5	3.30	0.70	2.60	1

3.3. Promethee Method.

With reference to (TABLE III) which is an observation table, the processed data using the promethee method will assign aggregate preference functions first, note (TABLE XI).

TABLE XI. AGGREGATE Promethee PREFERENCES FUNCTION

	K1	K2	K3	K4	K5
K1		0.110	0.189	0.139	0.012
K2	0.306		0.278	0.332	0.151
K3	0.303	0.195		0.320	0.032
K4	0.178	0.120	0.245		0.058
K5	0.463	0.404	0.402	0.470	

The end result of the promethee, determined from the Leaving Flow and the Entering Flow that is still partial, so combined with the mathematical process to rank, take note (TABLE XII).

TABLE XII. PROMENTHEE RANKING

Alt	Leaving Flow	Entering Flow	C-D	Ranking
K1	0.113	0.312	-0.200	5
K2	0.267	0.207	0.059	2
K3	0.213	0.278	-0.066	3
K4	0.150	0.315	-0.165	4
K5	0.435	0.063	0.371	1

Comparison Results Promotion based performance performanc sing three methods of VIKOR, ELECTRE, and Promethee can be seen in (TABLE XIII).

TABLE XIII. RANGKING OF VIKOR, ELECTRE, and PROMETHEE.

Alternatives	Promotion Base Position		
	VIKOR	ELECTRE	Promethee
K1	0.770	-1.250	-0.200
K2	0.636	0.140	0.059
K3	0.678	0.190	-0.066
K4	0.933	-1.680	-0.165
K5	0.000	2.600	0.371
Ranking	5-2-3-1-4	5-3-2-1-4	5-2-3-4-1

The results obtained provide an interpretation that the promethee method is closer to the actual results, while the vikor method is almost close to the results of truth and far away when compared with the electre method. Thus, it can be concluded that the best method for placing employee positions is the promethee method.

IV. CONCLUSION

The conclusions that can be drawn from Job Promotion for performance-based employees appear to be varied, with the VIKOR method in sequential first rank K5-K2-K3-K1-K4, with the weight in sequence is 0.0; 0.636; 0.678; 0.77, and 0.93. While the results of ranking with the method of ELECTREE in sequence is K5-K3-K2-K1-K4, with consecutive weights 2.6; 0.19; 0.14; -1.25; and -1.68. And the result of ranking with Promethee method in sequence is K5-K2-K3-K4-K1, with consecutive weights 0.371; 0.059; -0.066; -0.165, and -0.2. The results obtained provide an interpretation at the promethee method is closer to the actual results, while the vikor method is almost close to the results of truth and far away when compared with the electre method. Thus, it can be concluded that the best method for placing employee positions is the promethee method.

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