

**ASSESSING THE POTENTIAL OF DECISION SUPPORT SYSTEMS USING
THE ANALYTICAL HIERARCHY PROCESS AND TECHNIQUE FOR
ORDER OF PREFERENCE BY SIMILARITY TO IDEAL SOLUTION FOR
STRATEGIC STEAM SUPPLY PLANNING IN GEOTHERMAL FIELDS
UNIT 1-D1**

By

Muhammad Thasril
2245 2002

MASTER'S DEGREE
in

MECHANICAL ENGINEERING – ENGINEERING MANAGEMENT
FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY



SWISS GERMAN UNIVERSITY

The Prominence Tower

Jalan Jalur Sutera Barat No. 15, Alam Sutera

Tangerang, Banten 15143 - Indonesia

Revision after the Thesis Defense on August 15, 2025

STATEMENT BY THE AUTHOR

I hereby declare that this submission is my own work and to the best of my knowledge, it contains no material previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at any educational institution, except where due acknowledgement is made in the thesis.



Muhammad Thasril
Student

29 Aug 2025
Date

Approved by:



Dr. Ir. Maulahikmah Galinium, S.Kom., M.Sc.
Thesis Advisor

25 August 2025
Date



Assoc. Prof. Dr. rer. nat. Filiana Santoso
Thesis Co-Advisor

26 August 2025
Date



Dr. Ir. Maulahikmah Galinium, S.Kom., M.Sc.
Dean

25 August 2025
Date

ABSTRACT

By

Muhammad Thasril

Dr. Ir. Maulahikmah Galinium, S.Kom., M.Sc., Advisor

Assoc. Prof. Dr. rer. nat. Filiana Santoso, Co-Advisor

SWISS GERMAN UNIVERSITY

This study aims to evaluate the potential of a hybrid Decision Support System (DSS) that integrates the Analytical Hierarchy Process (AHP) and the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) to improve strategic steam supply planning at PT. XYZ's Geothermal Field Unit 1 D1. The research adopts a structured DMAIC (Define, Measure, Analyze, Improve, Control) framework. AHP was used to assign priority weights to four key decision criteria: change in wellhead pressure (ΔWHP), steam flow, cost, and success ratio. These weights were applied within the TOPSIS method to rank 11 candidate wells. Sensitivity analysis using the Weight Scaled Mean and Standard Deviation (WSMD) framework was conducted in the control phase to assess the robustness of the rankings under varying input scenarios. A flowchart was also developed to support future implementation and decision standardization. The findings indicate that the hybrid DSS provides a more transparent, structured, and stable decision-making process compared to the manual planning used in 2024. The approach also projects an estimated electricity gain of 364,464.04 kilowatt hours per day. In conclusion, the hybrid AHP–TOPSIS DSS enhances planning accuracy, reduces operational risk, and supports PT. XYZ's digital transformation goals.

Keywords: *Decision Support System, AHP, TOPSIS, Steam Supply Planning, Sensitivity Analysis, Geothermal Field, DMAIC, WSMD, Well Prioritization, Operational Risk*

© Copyright
by Muhammad Thasril
All rights reserved



DEDICATION

I dedicate this work to my beloved mother, Tengku Nuri Hasni, for her unwavering support, and to the memory of my late father, M. Syahrir Siradj, whose wisdom and principles continue to guide me. Finally, I dedicate this work to my beloved country, Indonesia, and to the organization I serve, with the sincere hope that its findings will contribute meaningfully to their continued growth through innovation, strategic insight, and professional dedication.



ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to my advisor and co-advisor for their invaluable guidance, support, and encouragement throughout the completion of this thesis. Their insights and feedback have been instrumental in shaping both the direction and quality of this research.

I am also deeply appreciative of all the lecturers at Swiss German University, whose teachings and academic guidance have significantly contributed to my knowledge and professional development.

I would like to extend my heartfelt thanks to my company for the opportunities, trust, and support provided during the course of this research. Special appreciation goes to my family—especially to Aliv Hanie Wulan—whose patience, understanding, and unwavering belief in me have been a continual source of strength and motivation. I also express my deepest love and gratitude to my children, whose joy and presence have been a continual inspiration throughout this journey.

Finally, I wish to thank all individuals who have contributed, either directly or indirectly, to the successful completion of this thesis. Your support has been truly invaluable.

TABLE OF CONTENTS

	Page
STATEMENT BY THE AUTHOR.....	2
ABSTRACT.....	3
DEDICATION.....	5
ACKNOWLEDGEMENTS.....	6
TABLE OF CONTENTS.....	7
LIST OF FIGURES	9
LIST OF TABLES.....	10
CHAPTER 1 – INTRODUCTION	11
1.1. Background.....	11
1.2. Research Problem	15
1.3. Research Objective	15
1.4. Research Question	15
1.5. Hypothesis.....	16
1.6. Research Scope and Limitation.....	16
1.7. Significance of Study.....	17
1.8. Thesis Structure	18
CHAPTER 2 - LITERATURE REVIEW	20
2.1 Decision support systems (DSS).....	20
2.2. Multi-Criteria Decision Making (MCDM)	22
2.3. AHP – TOPSIS	31
2.3. Strategic Steam Supply Planning.....	39
2.4. Related Work	46
CHAPTER 3 – RESEARCH METHODS	49
3.1. Research Framework	49
3.2. Analytical Method	51
3.3. Evaluation Method.....	53
3.4. Validation Method	54
CHAPTER 4 – RESULTS AND DISCUSSIONS.....	59
4.1. Overview.....	59
4.2. Data Obtained	59
4.3. Data Analysis	65

4.4. Discussion	73
CHAPTER 5 – CONCLUSIONS AND RECOMENDATIONS.....	80
5.1. Conclusions.....	80
5.3. Future Works	80
5.3. Recommendations.....	82
GLOSSARY	83
REFERENCES	86
CURRICULUM VITAE.....	86
APPENDIX.....	92



LIST OF FIGURES

Figures	Page
Figure 1.1 PT. XYZ Unit 1-D1 Location.....	11
Figure 1.2 Actual Power Plant Performance Index Unit 1-D1 in 2018-2023.....	12
Figure 1.3 Target vs Actual Trend Electricity Unit 1-D1 in 2018-2024.....	13
Figure 1.4 Strategic Mission of Company in the Proposed Long-Term Plan.....	14
Figure 2.1 Classification of MCDM	27
Figure 2.2 AHP Hierarchy Structure	32
Figure 2.3 Previous AHP Hierarchy	33
Figure 2.4 Geothermal Power Plant System in Unit 1-D1.....	40
Figure 3.1 DMAIC Framework	50
Figure 3.2 Zone in Weighted Mean vs. Standard Deviation plot	57
Figure 4.1 Result All Data Input Criteria Performance : Comparison of All Wells....	65
Figure 4.2 AHP-TOPSIS Rank Priority.....	68
Figure 4.3 WSMD Result: Sensitivity Analysis of Wells A–K.....	69
Figure 4.4 Flowchart Future Implementation: General Process of Strategic Steam Supply Planning Program	75
Figure 4.6 Flowchart Control Future Implementation: AHP – TOPSIS Process	77
Figure 4.7 Flowchart Control Future Implementation: Sensitivity Analysis Process..	78

LIST OF TABLES

Table	Page
Table 2.1 Type of Decision Support System	21
Table 2.2 Historical Milestones of MCDM	23
Table 2.3 Summarize categories of MCDM	28
Table 2.4 Summarize Matrix Comparison Mathematical Analytical (MA) Methods	30
Table 2.5 AHP Scale Instrument.....	33
Table 2.6 Output Pairwise comparison in criteria.....	34
Table 2.7 Output Priority Vector in criteria	34
Table 2.8 Random Consistency Index (RI).....	36
Table 2.9 Output Consistency in criteria	36
Table 2.10 Table Comparison of Related Work	48
Table 3.1 Analytical Method Based on Research Questions	52
Table 3.2 Evaluation Method Based on Research Questions	53
Table 3.3 Six Zone Classification of Weight-Scaled Mean and Standard Deviation	56
Table 4.1 Data Input of RQ1 & RQ2.....	60
Table 4.2 Data Input for Questionnaire	61
Table 4.3 Result Data Input: WHP & Steamflow	63
Table 4.4 Result Data Input: Cost.....	64
Table 4.5 Result Data Input: Success Ratio	65
Table 4.6 Result of Topsis Method	66
Table 4.7 Estimated Additional Power Generation Potential (kW/day) from Selected Wells Based on DSS Recommendation	71
Table 4.8 Table Comparison Manual Decision vs DSS Solution	72