

## 13th International Seminar on Industrial Engineering and Management

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**Bandung, Indonesia • 28 July 2021**

**Editors •** Winnie Septiani, Wahyukaton Wahyukaton,  
Rahmi Maulidya and Desinta Rahayu Ningtyas

## **Preface: 13<sup>th</sup> International Seminar on Industrial Engineering and Management**

*Bismillahirrahmanirrahim,  
Assalamu'alaikum Warrahmatullah Wabarakatuh*

First of all, we apologize for the inconvenience in the 13th ISIEM 2021 event, due to the current conditions and situation of COVID 19. The situation made us have to make some critical modifications in the event, including: online presentation of the keynote speaker, online presentation for all candidates that cannot attend the seminar, but we hope we all remain excited to continue to contribute to research publications. Nonetheless, we are trying to prepare this seminar as best we can.

This issue is published in line with the Thirteen International Seminar on Industrial Engineering and Management (13<sup>th</sup> ISIEM) 2021. The articles cover a broad spectrum of topics in Industrial Engineering and Management, which are Quality Engineering Management, Decision Support System and Artificial Intelligent, Ergonomics, Supply Chain Management, Production System, Operation Research, and Industrial Management. These articles provide an overview of critical research issues reflecting on past achievements and future challenges. Those papers were selected from 137 abstracts, and we send these papers to AIP to be published there as an Open Access Proceeding Scopus. This statistic shows the high competition to get published on this proceeding. This issue and seminar become special as more delegates come and join from various country as well as universities. We host 90 delegates both from abroad and local.

The 13<sup>th</sup> ISIEM is hosted by eight universities, which are Universitas Pasundan, Universitas Esa Unggul, Universitas Trisakti, Universitas Tarumanagara, Universitas Al-Azhar Indonesia, Atma Jaya Catholic University of Indonesia, Universitas Pancasila and Universitas Mercubuana. This is the thirteenth years of the collaboration of those universities, and the first time we had MOU with AIP in America to publishing the papers that is indexed by Scopus.

In this occasion, let us give special thanks to Prof. Yung-Tsan Jou, PhD (Professor and Chair Department of Industrial and Systems Engineering, Chung Yuan Christian University – Taiwan), Prof. Yun-Chia Liang, PhD (Professor and Chair, Department of Industrial Engineering and Management, Yuan Ze University – Taiwan), Elisa Lumbantoruan (President Director & CEO at ISS Indonesia, Independent Commissioner at PT Indosat Tbk, and Independent Commissioner at Garuda Indonesia) and Naraphorn Paoprasert, Ph.D (Researcher, Department of Industrial Engineering, Faculty of Engineering, Kasetsart University – Thailand), for their contribution as keynote speakers. We are also grateful to all reviewers and editors, for their commitment, effort and dedication in undertaking the task of reviewing all of the abstracts and full papers. Without their help and dedication, it would not be possible to produce this proceeding in such a short time frame. I highly appreciate all members of committees (advisory, steering, and organizing committees) for mutual efforts and invaluable contribution for the success of seminar.

*Wassalamu'alaikum Warrahmatullah Wabarakatuh.*

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Dr. Winnie Septiani, ST, MSi, CIQaR

Chairman

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[Production and Service System in The New Normal Era]



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July 28, 2021

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## Table of Contents

1.	13th-ISIEM-Paper 002 – QM .....	34
	Reducing Defect Products in Instant Noodles Production with Six Sigma	
2.	13th-ISIEM-Paper 006 – IECS .....	34
	Structural Health Monitoring for Intelligence Structure: Damage Feature	
3.	13th-ISIEM-Paper 007 – PS .....	34
	Inventory Level Improvement with a Forecasting Methods in the Taxi Transportation Industry	
4.	13th-ISIEM-Paper 008 – SCM .....	35
	Bibliometric Mapping Of Biomass For Energy Supply Chain Model: Review and Future Research agenda	
5.	13th-ISIEM-Paper 009 – EPD .....	35
	Finding a Research Gap on Service Quality and Safety Improvement in Public Transportation	
6.	13th-ISIEM-Paper 010 – DAIS .....	35
	Decision Support System for Raw Material Supplier Selection by Using Fuzzy AHP-TOPSIS Method in PT Mulia Glass	
7.	13th-ISIEM-Paper 011 – SCM .....	36
	Methods and Approaches Mapping for Supplier Selection: Literature Review	
8.	13th-ISIEM-Paper 012 – EPD .....	36
	Redesign Plastic Waste Processing Machine by Using the Lean Product Development Method	
9.	13th-ISIEM-Paper 013 – EPD .....	37
	Risk Analysis and Safety Improvement of Plastic Waste Processing Machine	
10.	13th-ISIEM-Paper 014 – DAIS .....	37
	YBM University Tourism Building Location Selection With A Combination of Cut Off Point And AHP Topsis Method	
11.	13th-ISIEM-Paper 015 – DAIS .....	37
	Evaluation of E- Learning Implementation Using Student Readiness Instrument	
12.	13th-ISIEM-Paper 016 – IS .....	38
	Exploring Customer Sentiment Regarding Indonesian Online Transportation Services: Evidence from Twitter Social Media	
13.	13th-ISIEM-Paper 017 – DAIS .....	38
	The Blue Print of Intelligent Decision Support System for Supply Chain Kenaf Agroindustry	
14.	13th-ISIEM-Paper 018 – IECS .....	38
	Simulation Modelling of a Train Station Ticketing System: A Case Study of Zhongli Train Station in Taiwan	
15.	13th-ISIEM-Paper 019 – IECS .....	39
	Design and Evaluation of LoRa-based Mesh Network for Water Metering Infrastructure	
16.	13th-ISIEM-Paper 020 – IS .....	39
	A Maturity Model of I4.0 in Developing Country: Challenges and Enablers in Indonesia for Using INDI 4.0 as A Measuring Instrument of I4.0 Readiness	
17.	13th-ISIEM-Paper 021 – DAIS .....	40
	Resilient and Sustainable Supplier Selection: Trends in Criteria and Methods	
18.	13th-ISIEM-Paper 022 – OR .....	40
	Parameter Tuning for Combinatorial Bees Algorithm in Travelling Salesman Problems	
19.	13th-ISIEM-Paper 023 – SCM .....	40
	Research Opportunities on Energy Supply Chain Management	
20.	13th-ISIEM-Paper 024 – QM .....	41
	Analysis of Big Losses to Increase Productivity with SMED Method in Hand Sanitizer Products	
21.	13th-ISIEM-Paper 025 – IS .....	41
	Analysis of Optimistic Bias and Pessimistic Bias in Preparation for The New Normal	
22.	13th-ISIEM-Paper 026 – EPD .....	41
	Analysis of Work System to Productivity with Work Stress as Moderating Variable	

23.	13th-ISIEM-Paper 028 – DAIS .....	42
	Design of Sales Information System Based on Website at Amonyu Shop	
24.	13th-ISIEM-Paper 029 – DAIS .....	42
	Decision-Making for Conducting Seismic-Surveying Activities on Oil and Gas Exploration Using Decision Tree and Utility Functions	
25.	13th-ISIEM-Paper 030 – OR.....	42
	Dynamic Programming for Shortest Path Problem in a Multi-modal Transportation Network Comprising Intermediate Sinks	
26.	13th-ISIEM-Paper 031 – SCM .....	43
	Hybrid Simulation of Supply Chain : A Review	
27.	13th-ISIEM-Paper 032 – DAIS .....	43
	A Conceptual Framework for An Adaptive Sustainability Assessment for Industry and Further Research Potential	
28.	13th-ISIEM-Paper 033 – QM .....	44
	Improve The Quality of Korean Garlic Cheese Bread Using The Six Sigma Method	
29.	13th-ISIEM-Paper 034 – SCM .....	44
	Analyzing the Gap in Supply Chain Business Process of National Engineering Procurement Construction (EPC) Company Using Rapid Assessment Procedure	
30.	13th-ISIEM-Paper 035 – SCM .....	44
	Impact of Supply Chain Practices on Customers' Retention	
31.	13th-ISIEM-Paper 036 – OR.....	45
	Application of Fourier Grey Model (FGM) For Demand Forecasting and Markov Chain Method for Inventory Planning	
32.	13th-ISIEM-Paper 037 – EPD .....	45
	Usability Evaluation And Improvement Design Of Hospital Mobile Website	
33.	13th-ISIEM-Paper 038 – IS .....	45
	Waste Reduction Strategy Design Based on Risk Assessment and Cost Benefit Approach	
34.	13th-ISIEM-Paper 040 – DAIS .....	46
	E-Commerce Application of Oil Palm Fresh Fruit Bunches Supply Chain	
35.	13th-ISIEM-Paper 041 – PS .....	46
	Design Model Forecasting and Delivery Requirement Planning for Fast Food Product	
36.	13th-ISIEM-Paper 042 – EPD .....	46
	Comparative Analysis of Mental Workloads For Disruption Technicians And New Installation Technicians Using The NASA-TLX Method (Case Study: PT Telkom Akses Kandatel Sleman)	
37.	13th-ISIEM-Paper 043 – DAIS .....	47
	Warehouse Management Analysis with Value Stream Mapping and 5S to Improve Efficiency Process Productivity	
38.	13th-ISIEM-Paper 044 – IS .....	47
	Increasing Consumer Satisfaction and Loyalty with Product Innovation, E-Commerce and Reward Factors	
39.	13th-ISIEM-Paper 045 – PS .....	48
	The Smart Factory Model for Bogie Assembly Workshop in the Rolling Stock Industry	
40.	13th-ISIEM-Paper 046 – DAIS .....	48
	Implementation of Artificial Intelligence in Improving The Quality of Service System in Telecommunications Industry	
41.	13th-ISIEM-Paper 048 – QM .....	48
	Production Quality Improvement Through Six Sigma: A Crude Palm Oil Industry Case Application	
42.	13th-ISIEM-Paper 049 – IS .....	49
	Strategy Designed toward Performance Improvement of Asset Management System	
43.	13th-ISIEM-Paper 050 – PS .....	49
	Development of Operation Scheduling Systems at Workstations with the Autonomous Distributed Manufacturing Systems (ADiMS) Concept	

44.	13th-ISIEM-Paper 051 – QM .....	49
	Design and Implementation of Quality Metric Using Internal Control Method for Quality Control of Pertamina SPBU Digitization Project (Case Study PT XYZ)	
45.	13th-ISIEM-Paper 052 – DAIS .....	50
	Determination of Performance Ranking of MSMEs using Simple Additive Weighting Approach	
46.	13th-ISIEM-Paper 053 – IS .....	50
	Sustainability Index Measurement for Furniture Manufacture Strategy	
47.	13th-ISIEM-Paper 054 – EPD .....	50
	Analysis of Quality Preferences for Cassava Chips Products	
48.	13th-ISIEM-Paper 055 – PS .....	51
	Application of the Lean Method in Designing Layout of 4.0 Rubber and Plastic Manufacturing Plants	
49.	13th-ISIEM-Paper 056 – IECS .....	51
	The Effect of Problem Based Learning Method to Student Online Learning Performance During Covid-19	
50.	13th-ISIEM-Paper 057 – IECS .....	51
	Online Business System Design and Business Finance of Islamic Boarding School X Turmeric Powder in Selaawi	
51.	13th-ISIEM-Paper 058 – IS .....	52
	Design of Conceptual Models for Comparison Analysis Between Conventional Methods And MCP Methods Based on Productivity and Logistic Performance in Cooperative X	
52.	13th-ISIEM-Paper 059 – PS .....	52
	Waste Identification Using Value Stream Mapping in the Pig Launcher Production Process	
53.	13th-ISIEM-Paper 060 – EPD .....	53
	Ergonomic Design Improvement of Plastic-Waste Processing Machine Based on Posture Analysis	
54.	13th-ISIEM-Paper 061 – IS .....	53
	Framework of Service Quality Evaluation in Supply Chain Management Using Integration of SERVQUAL, Kano and QFD in Cigarette Company XYZ: A Literature Review	
55.	13th-ISIEM-Paper 062 – IS .....	53
	Block Layout for Stationery Store Using Data-driven and Market Basket Analysis	
56.	13th-ISIEM-Paper 064 – OR .....	54
	Determining the Location of Temporary Landfills with Simultaneous Set Covering Model	
57.	13th-ISIEM-Paper 065 – IECS .....	54
	Design of Website and Web-Based Information System User Interface of PT XYZ with Human Centered Design Method	
58.	13th-ISIEM-Paper 066 – DAIS .....	54
	Clustering the Micro, Small and Medium Enterprises (MSMEs) in Yogyakarta City based on Technology Readiness Index 2.0 using K-Means Method	
59.	13th-ISIEM-Paper 067 – QM .....	55
	Analysis of the Relationship between Composite Board Thickness and Its Ability to Muffle Sounds	
60.	13th-ISIEM-Paper 068 – QM .....	55
	Assesment for Technical Disruption Priority of Facilities By Used DMAIC Approach With FMEA Tool For Computer Electric Train	
61.	13th-ISIEM-Paper 069 – IS .....	55
	An Evaluation of the Production Risk of Broilers Day Old Chicks in the Hatchery Unit using Z Score and Value at Risk	
62.	13th-ISIEM-Paper 070 – QM .....	56
	Actor-Objectives Analysis in Technology Transfer Systems in Agricultural Technology Parks Using MACTOR Analysis	
63.	13th-ISIEM-Paper 071 – QM .....	56
	Improving Capacity and Production Quality of The Footwear Industry: A Case Study of Binh Tien Company Limited, Vietnam	

64.	13th-ISIEM-Paper 073 – PS .....	57
	Lean Manufacturing Implementation Strategy in The Pharmaceutical Industry Production Processes: A VSM And AHP Approach	
65.	13th-ISIEM-Paper 074 – SCM .....	57
	A Conceptual Modelling of Digital Contract for Independent Palm Oil Supply Chain Systems	
66.	13th-ISIEM-Paper 075 – SCM .....	57
	Data Mining Based Framework For Identification and Disaster Risk Assessment in The Supply Chain	
67.	13th-ISIEM-Paper 076 – IS .....	58
	Brand Awareness Building Through Social Media (Facebook and Instagram) (case study: GianTree Startup)	
68.	13th-ISIEM-Paper 077 – EPD.....	58
	Usability Testing and Heuristic Evaluation for Improving Usability Registration of Website Hospital	
69.	13th-ISIEM-Paper 078 – SCM .....	58
	Optimization Hand Sanitizer Distribution Route to Public Facilities in Palembang City	
70.	13th-ISIEM-Paper 079 – QM .....	59
	Capability Process on Shewhart p Control Chart and ISRT p EWMA Control Chart on Shift Drum Production	
71.	13th-ISIEM-Paper 080 – IS .....	59
	Key Drivers of Sustainable Maintenance Practices for Automotive Industry	
72.	13th-ISIEM-Paper 082 – IECS.....	59
	Basic Model Simulation for Disaster Evacuation Routes Evaluation using Agent Based Modeling (ABM)	
73.	13th-ISIEM-Paper 083 – EPD .....	60
	A Crusher Machine Design at PT XYZ Using Rational Product Design Method	
74.	13th-ISIEM-Paper 084 – EPD.....	60
	Design of handgrip for commuter line electric train using House of Quality (HOQ)	
75.	13th-ISIEM-Paper 085 – IS .....	60
	Sustainable Product and Service Systems Engineering: Engineering Multidisciplinary and Stakeholders Perspectives on Strategic Marketing	
76.	13th-ISIEM-Paper 086 – SCM .....	61
	Analysis of Mercury Lamp Recycling to Implement the Circular Supply Chain	
77.	13th-ISIEM-Paper 087 – PS .....	61
	The Mushroom Media Cultivation using Green Productivity Methodology	
78.	13th-ISIEM-Paper 088 – DAIS .....	61
	Decision Support System for Business Location Selection and Economic Feasibility	
79.	13th-ISIEM-Paper 089 – IECS.....	62
	Structural Equation Modelling for IoT and Big Data Implementation in Business Performance	
80.	13th-ISIEM-Paper 091 – SCM .....	62
	Structure Analysis and Supply Chain Strategy Development for Natural Rubber Production in West Aceh District	
81.	13th-ISIEM-Paper 092 – QM .....	63
	Investigating the Effect of Room Air-Conditioning Temperature on Force Resistance of 3D Printer Hook Using Taguchi Method	
82.	13th-ISIEM-Paper 095 – IECS.....	63
	Exploration of Data Science Expertise in Indonesia: Study Case of Industry in Jakarta Metropolitan Area	
83.	13th-ISIEM-Paper 097 - DAIS.....	63
	User Centered Requirements Engineering Method for Library Information System: A Case from High School Library	
84.	13th-ISIEM-Paper 098 – SCM .....	64
	Reduction of the Bullwhip Effect Using Vendor Managed Inventory Case Study Bottled Drinking Water	
85.	13th-ISIEM-Paper 099 – IS .....	64
	Analytical Study on Power Supply Company Productivity: A Case Study in Indonesia	
86.	13th-ISIEM-Paper 100 – PS .....	64
	Forecasting Product Returns using Artificial Neural Network for Remanufacturing Processes	

87.	13th-ISIEM-Paper 101 – EPD .....	65
	Mental Workload Analysis of Workers in the Textile Manufacturing Company during the Covid-19 Pandemic using NASA-TLX	
88.	13th-ISIEM-Paper 102 – OR .....	65
	Simulation of Two Channels, Single-Phase Queuing System Using Monte Carlo Model in A Government Office	
89.	13th-ISIEM-Paper 103 – IECS .....	65
	Increasing Utilization of Production Facility Based on Simulation Model Approach at PT.XAX	
90.	13th-ISIEM-Paper 104 – DAIS .....	66
	Agglomerative Hierarchical Clustering in Determining the Location of Bio-briquette Plant in Majalengka Regency	
91.	13th-ISIEM-Paper 106 – EPD .....	66
	Eye-Tracking Approach for Analyzing the Advertisement Criteria of the Most Attractive Sports Drinks	
92.	13th-ISIEM-Paper 107 – QM .....	66
	Performance Maintenance Evaluation and Determination of Machine Maintenance Schedule in PT. Hamdan Jaya Makmur Workshop Division	
93.	13th-ISIEM-Paper 108 – QM .....	67
	Quality Improvement on Pipe Production Using Six Sigma and Data Mining in PT. FIP	
94.	13th-ISIEM-Paper 109 – DAIS .....	67
	Hospitality Food and Beverage Production with ERP System Using Odoo and Rapid Application Development (RAD) Method	
95.	13th-ISIEM-Paper 110 – IECS .....	68
	Sustainable Product Design Engineering in Industry 4.0: Civilian and Military Drones vis-à-vis Digital Transformation	
96.	13th-ISIEM-Paper 111 – IECS .....	68
	Application of Machine Learning Algorithms on the Multi-feature Multi-classification Problem - in the Case of a Hydraulic System	
97.	13th-ISIEM-Paper 112 – EPD .....	68
	Designing Persuasive Technology Applications to Solve Human Behavior Problems: Enhancing Better Lifestyle On Millennials	
98.	13th-ISIEM-Paper 113 – EPD .....	69
	Ergonomic Risk Analysis of Tofu Cutting Process at Raimin's Small and Medium Enterprise	
99.	13th-ISIEM-Paper 114 – IECS .....	69
	Simulation based Facility Location Modelling in A Sustainable Closed-Loop Supply Chain Network	
100.	13th-ISIEM-Paper 115 – OR .....	70
	Multiobjective Heterogeneous Vehicle Routing Problem with Multi-Trips in Urban Logistics Context	
101.	13th-ISIEM-Paper 116 – QM .....	70
	Utilizing Integrated Performance Measurement System and Analytical Hierarchy Process for Competitive Advantage	
102.	13th-ISIEM-Paper 117 – IECS .....	70
	Designing Marketing Information System for Coconut Derivative Products in Padang Pariaman .....	
103.	13th-ISIEM-Paper 118 – SCM .....	71
	Supply Chain Design by Developing Causal Loop Diagram for Patchouli Oil Business	
104.	13th-ISIEM-Paper 120 – DAIS .....	71
	Clustering on Small and Medium Scale Manufacturing Industry in Jakarta using Fuzzy Cluster Means	
105.	13th-ISIEM-Paper 121 – SCM .....	71
	Sustainable Supply Chain Analysis and Risk Prevention Business Process Using House of Risk Model	
106.	13th-ISIEM-Paper 122 – IECS .....	72
	Proposed Development Process to Improve Customer Quality of Service with Fuzzy-Servqual and Data Mining Methods in Insurance Agency	

107.	13th-ISIEM-Paper 123 – OR.....	72
	Optimization of Capacitated Vehicle Routing Problems for Basic Needs of Urban Logistics - The Case of The City of Bandung	
108.	13th-ISIEM-Paper 124 – IS.....	72
	Evaluation of Service Transformation during COVID-19 Pandemic: A Case Study at DISPENDUKCAPIL Surabaya	
109.	13th-ISIEM-Paper 125 – DAIS.....	73
	Deep Walk and PCA Based Conceptual Model of Sustainable Packaging Design	
110.	13th-ISIEM-Paper 126 – IS.....	73
	Evaluation Performance of Online Learning in Indonesian Higher Education Institution During Pandemic Covid-19	
111.	13th-ISIEM-Paper 127 – IS.....	74
	Opportunity and Challenge for Small Wind Power Project in Indonesia	
112.	13th-ISIEM-Paper 128 – IS.....	74
	Investigating Student Anxiety Factors among International Student (Case Study: Indonesian Private University)	
113.	13th-ISIEM-Paper 129 – IS.....	74
	Designing Risk Response from Qualitative Analysis, A Strategy to Avoid the Project Failure (Case Study: Coffee Plant Construction Project)	
114.	13th-ISIEM-Paper 130 – IS.....	75
	Risk Assessment Design and Risk Mitigation in The Telecommunication Network Infrastructure Project (Case Study of Migration Project)	
115.	13th-ISIEM-Paper 131 – EPD.....	75
	New Area of Food Packaging Design Research: A Systematic Review	
116.	13th-ISIEM-Paper 132 .....	75
	Effect of Exposure Time And Elevated Temperature On Plain Concrete	
117.	13th-ISIEM-Paper 133 .....	76
	Strengthening of Cylinders Concrete Confined with Glass-Reinforced Polymer	
118.	13th-ISIEM-Paper 134 .....	76
	Glass Fiber as Reinforcement In Cement Mortar for The Repair of Plain Concrete Members	
119.	13th-ISIEM-Paper 135 .....	77
	Construction Waste Quantification and Benchmarking in Libya	
120.	13th-ISIEM-Paper 136 – QM .....	77
	Improving Workflow of Aircraft Maintenance for Reduce Lead-time on Nine-Passenger Aircraft	
121.	13th-ISIEM-Paper 137 – IS .....	77
	Comparing the Effect of Electronic Word of Mouth (eWOM) in Facebook and Instagram on Donation Intention during Earthquakes in Indonesia	
122.	13th-ISIEM-Paper 138 – EPD .....	78
	Mapping of Noise Contours due to the Production Process of Bolts and Nuts in the Production Department and Residences Environment of Pasir Angin Village, Cileungsi, Bogor Regency	
123.	13th-ISIEM-Paper 139 – IS .....	78
	Selection Decoration Services Business Development Strategy to Elevate Sustainable Competitive Advantages: A Case Study of Mau Dekorin	
124.	13th-ISIEM-Paper 140 – IS .....	78
	Designing Master Plan for Website and Information System Project of Smart Campus ABC University in PT. XYZ	
125.	13th-ISIEM-Paper 141 – QM .....	79
	Improvement of Process Quality Using Taguchi Method on Solvent Production	
126.	13th-ISIEM-Paper 142 – IS .....	79
	Age Replacement Scheduling On Total Organic Carbon Analyzer Instrument (TOC) at XYZ Pharmaceutical, Ltd	

127. 13th-ISIEM-Paper 143 – IS .....	79
The Utilization of Information Technology: Live Stream Shopping as an Innovation Strategy to Increase Online Store Sales in the Pandemic Period	
128. 13th-ISIEM-Paper 144 – EPD .....	80
Utility of Reaction Time in Measuring Fatigue Associated with Short-Period, High-Cognitive Load Task	
129. 13th-ISIEM-Paper 145 – IECS .....	80
Binary Coding Enumeration for Multi-dimensional Problem in Sculptured Dies Cavity Roughing Optimization	
130. 13th-ISIEM-Paper 146 – IECS .....	81
Three-Dimensional Object Measurement Model Image Processing System Based to Calculate Logistics Cargo Rates	
131. 13th-ISIEM-Paper 147 – IS .....	81
The Use of QR Code in Restaurant Service: the Consumer Readiness	
132. 13th-ISIEM-Paper 148 – IS .....	81
Strategy Analysis of Fire Victims Evacuation Queues on Building Areas in Compliance with SMK3 Regulations in order to Green Campus (Case Study of the Faculty of Engineering, Pancasila University (FTUP))	
133. 13th-ISIEM-Paper 149 – QM .....	82
Reduction of Bolt Product Defects at PT. GIP Using Six Sigma Method	
134. 13th-ISIEM-Paper 150 – OR .....	82
Applying Genetic Algorithm for Capacitated Vehicle Routing Problem and Vehicle Selection- Case Study of Vietnam Logistics Company	
135. 13th-ISIEM-Paper 151 – QM .....	83
Risk analysis of the Madura-3 corn supply chain using the FMEA Method	
136. 13th-ISIEM-Paper 152 – IS .....	83
Environmental, Social and Governance (ESG) Strategy Implementation Plan During the Covid-19 Pandemic at Retail Company "X" in Jakarta	

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## Proposed development process to improve customer quality of service with fuzzy-servqual and data mining methods in insurance agency FREE

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# Proposed Development Process to Improve Customer Quality of Service with Fuzzy-Servqual and Data Mining Methods in Insurance Agency

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**Abstract.** This study aims to measure and analyze customer satisfaction with the services provided by OV Agency agents. Methos The data used in the study are questionnaires filled by 100 random customers from OV Agency. The study used the Fuzzy-ServQual method and data mining with the Classification-Decision Tree algorithm. Fuzzy-ServQual is used to measure attributes that need to be improved based on the calculation of GAP values with the addition of fuzzy methods to eliminate the obscurity obtained from the results of the questionnaire. The Data Mining Classification Method was used to determine hidden patterns by a decision tree. The results of the calculation of the overall GAP value on the Fuzzy-ServQual method are -0.008 and there are 10 attributes that require improvement. Decision trees are using the Rapid Minner Studio application. Based on the decision tree obtained, if then rule can be obtained as a pattern of satisfaction and dissatisfaction.

**Keywords:** Service Quality, Fuzzy-ServQual, Data Mining, Classification-Decision Tree

## INTRODUCTION

Companies in the service sector are required to improve service quality to increase high global competition. The research is in insurance company. This study aims to analyze agent services to customers using the Fuzzy-ServQual method and Classification-Decision Tree Data Mining.

OV agency gets customer dissatisfaction regarding the services provided by agents. This can be caused by the lack of commitment of the agents in explaining insurance products and reminding clients to pay the premium. In addition, the standard and quality of marketing and service between OV agency agents are not uniform. With the decrease in the level of customer satisfaction with the performance of sales agents, it can reduce the productivity of OV agency.

This study aims to improve the quality of customer service which can be described as follow to know the level of customer satisfaction with the performance of OV agency sales agents, to analyze the calculation of Gap values from the questionnaire and providing suggestions for improving customer service quality using the Fuzzy-ServQual method, to analyze the classification and provide suggestions for improving customer service quality using the Classification-Decision Tree Data Mining method.

Sampling technique is a technique in sampling that will be used in research. The sample is part of the number and characteristics possessed by the study population [1]. Determining the number of samples that is most appropriate to use in research depends on the level of accuracy / desired error. The greater the level of error, the smaller the number of samples needed, and conversely the smaller the level of error, the greater the number of samples needed. Determine the number of samples with a 5% error rate based on the Isaac Michael formula as follows:

$$s = \frac{\lambda^2 \cdot N \cdot P \cdot Q}{d^2(N-1) + \lambda^2 \cdot P \cdot Q} \quad (1)$$

Information:

s = number of samples

$\lambda$  = degree of trust

N = population

d = degree of error

P = proportion of target population (50%)

Q = proportion of target population (50%)

There are many research about quality service. Customer satisfaction is the key to creating customer loyalty. Many benefits are received by the company by achieving a high level of customer satisfaction, which is in addition to increasing customer loyalty but can also prevent customer turnover, reduce customer sensitivity to prices, reduce marketing failure costs, reduce operating costs caused by increasing numbers of customers, increase advertising effectiveness, and improve business reputation [2].

There are many research about fuzzy servqual. The study of the quality of service by the patient BPJS Health, the highest gap value is the empathy dimension and the lowest gap is the dimension of tangibles (physical proof) thus it can be seen that the dimensions of tangibles (physical evidence) is of concern to improve service quality [3]. The research that measured the service quality by using Fuzzy Servqual by determining the gap between expectations with consumer perception, determining the level of significance between expectations with consumer perceptions, determining the level of service quality and suggesting improvement based on priority by looking at the gap of each quality dimension. Based on the results of data processing, it can be seen that the level of service quality is still low seen from the value of Q t-table[4]. The research evaluated the quality of a large hotel through the fuzzy SERVQUAL and fuzzy AHP. The results showed that the services have many gaps to be improved.[4]

The classification process is a complex technique that connects language, text, information and knowledge theories with computational formalisation, statistical and symbolic approaches, standard and non-standard logics, etc. The propose in this paper a formal model with strong logical foundations based on applicative type systems.[5]

The previous research and the research position can be seen in Table 1.

TABLE 1. Research Position

NO	METHOD	SOURCE
1	Integration of quality service, customer satisfaction, Customer Loyalty, non-probability purposive sampling technique, Structural Equation Modeling	[2]
2	Integration between Fuzzy and Servqual	[3]
3	Integration between the fuzzy SERVQUAL and fuzzy AHP	[4]
4	Integration between classification, applicative systems, collaborative intelligent science	[5]
5	Data Mining classification methods: decision tree (J48), neural Network (MLP) and naive Bayes	[6]
6	Integration between Fuzzy, Quality Function Deployment, and Data Mining	[7]
7	Integration between Six Sigma, FMEA, and Data Mining	[8]
8	Integration between SERVQUAL, Analytical Hierarchy Process (AHP) and Citizen's Score Card	[9]
9	Integration SERVQUAL, service quality, safety concerns and maintenance	[10]
10	Integration between Fuzzy, Servqual, Data Mining	This research position

The position of this research among other studies around the world, can be seen from various aspects above. Can be seen from the aspect of Quality Control research methodology is a combination of fuzzy and method of Servqual, where Servqual is applied simultaneously with fuzzy logic to reduce the subject subjectivity of respondents. Data mining method is also used to know the classification of satisfaction level on OV Agency

## RESEARCH METHODOLOGY

The flow of the research methodology can be seen in Figure 1. The results of processing Fuzzy-ServQual methods and Data Mining Classification-Decision Tree. From data processing using the ServQual method, the output value gap is obtained which indicates satisfaction of customers' dissatisfaction with the services of the agents. In the Data Mining method Classification-Decision Tree is expected to output is a decision tree-shaped classification that can be used to make an if then rule. The results of the analysis obtained are used as a reference for making proposals.

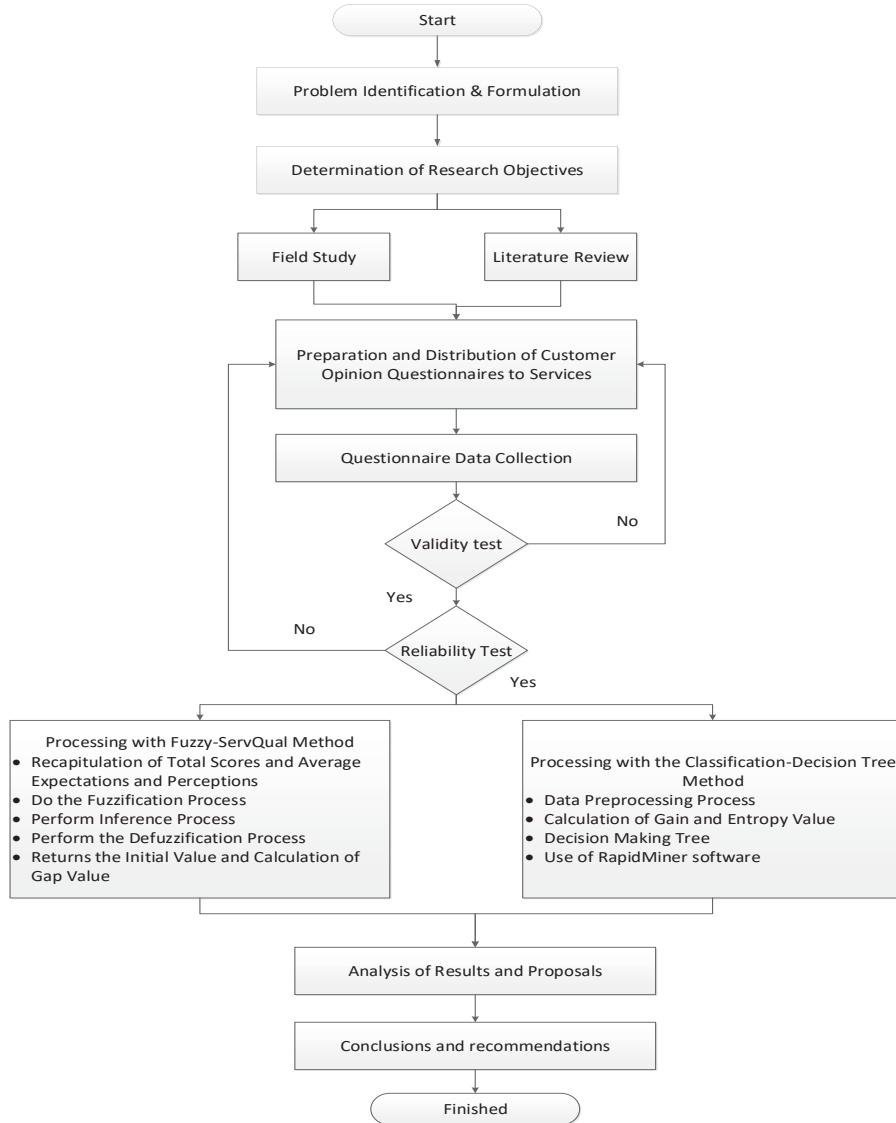


FIGURE 1. Research Methodology Flowchart

## RESULTS AND DISCUSSION

Determining the number of samples that is most appropriate to use in research depends on the level of accuracy / desired error. The greater the level of error, the smaller the number of samples needed, and conversely the smaller the level of error, the greater the number of samples needed. Determine the number of samples with a level of error of 5% based on the isaac michael formula as follows:

$$S = \frac{0.95^2 \times 12000 \times 0.5 \times 0.5}{0.05^2 (12000 - 1) + 0.95^2 \times 0.5 \times 0.5} = 89.583 \approx 90$$

Through the above calculations, it was found that the number of sample questionnaires needed was 90 respondents, and rounded up to 100 respondents on the google form.

Respondents' demographics are an important factor in seeing market segmentation, and based on these demographics, it can be seen how the behavior of the consumers studied.

In this study, by the SPSS, 25 program was used in testing validity. Tests were carried out 2 times, namely for the results of the questionnaire questions, the perceptions and questions of respondents' expectations of the performance and service of the OV agency agents.

The validity test calculation uses the value of the table with a 2-way test and a significance level of 5%. The value of freedom degree (dF) is obtained using calculation (dF) = N-2 with N = 100. The results of calculation of degrees of freedom (dF) are 98 with table value = 0.1966. Data is declared valid if the calculated value is greater than the table value. A variable is said to be reliable if it gives an alpha cronbach value > 0.60. After calculating using SPSS 25, the Cronbach alpha value for perception is 0.905 and the Cronbach alpha value for expectation is 0.830. Based on the results of calculations, questionnaire data can be concluded for reliable perceptions and expectations.

## Fuzzy-ServQual Method

The first step is to calculate the value of the total score of perception and expectation. The following is a sample calculation of total scores and average scores for questions of perception and expectation.

1. Calculation of question number 3 (Q3) part of perception

$$\text{Total Score} = (0 \times 1) + (7 \times 2) + (32 \times 3) + (46 \times 4) + (15 \times 5) = 369$$

$$\text{Average Score} = 369/100 = 3.69$$

2. Calculation of question number 3 (Q3) part of hope

$$\text{Total Score} = (0 \times 1) + (0 \times 0) + (8 \times 3) + (39 \times 4) + (53 \times 5) = 445$$

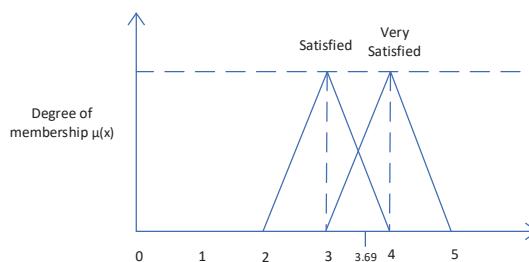
$$\text{Average score} = 445/100 = 4.45$$

The next stage is the fuzzification calculation of the questionnaire questions of perception and expectation [9]. The following are examples of fuzzification calculations from questions of perception and expectation number 3 (Q3).

1. Question number 3 (Q3) Perception

Based on the calculation of the average total score obtained x value of 3.69. Then the fuzzification calculation is as follows:

- Satisfied and Very Satisfied Categories
- Membership function



**FIGURE 2.** Graph of Fuzzy Set Questions Number 3 (Q3) Perception

Fuzzy Set function is in the satisfied and very satisfied category because x = 3.69.

2. Question Number 3 (Q3) Hope

Based on the calculation of the average total score obtained x value of 4.45. Then the fuzzification calculation is as follows:

- Very Satisfied Category
- Membership function
- Fuzzy Set function

Because x = 4.45 and the classification is very satisfied then

$$\mu_{\text{very satisfied}}(4,45, 3, 4, 5) = \frac{5 - 4,45}{5 - 4} = 0,55 \text{ for } 4 < x < 5$$

The inference process is the reasoning used based on the composition of the min. This process consists of determining the rules of the bounding value of each set in each variable and determining the predicate value.

$$Y' = \frac{\sum(yi * wi)}{\sum wi} \quad (2)$$

After defuzzification results for each question attribute, the next step is to determine the ServQual value by determining the gap value, determining the weight and determining the weighted gap which is the final result of the ServQual score. To determine the gap value the formula is used:

$$\text{Gap} = \text{Performance} - \text{Hope} \quad (3)$$

While the weight value is obtained from the number of attribute questions that exist. Because the questions amount to 15 each questionnaire, the weight values are:

$$\text{Weight} = 1/15 = 0.067$$

Then, the next step is to determine the weighted gap which is the final ServQual score using the approach:

$$\text{ServQual score (weighted gap)} = \text{Gap value} \times \text{Weight} \quad (4)$$

Recapitulation of calculation of ServQual values based on service quality attributes can be seen in Table 2.

TABLE 2. Recapitulation of Defuzzification and Value of GAP

Number	Dimension	Code	Defuzzification Perception	Defuzzification Expectation	GAP (P-E)	Weight (1/15)	GAP Weighted	Rank
1	Reliability	Q3	3.69	4	-0.31	0.067	-0.021	2
		Q4	4	4	0	0.067	0.000	11
		Q10	3.89	4	-0.11	0.067	-0.007	7
		Q11	3.96	4	-0.04	0.067	-0.003	10
2	Assurances	Q9	4	4	0	0.067	0.000	12
		Q15	3.94	4	-0.06	0.067	-0.004	9
3	Tangibles	Q13	3.89	4	-0.11	0.067	-0.007	8
		Q14	4	4	0	0.067	0.000	13
		Q1	4	4	0	0.067	0.000	14
4	Empathy	Q5	4	4	0	0.067	0.000	15
		Q6	3.62	4	-0.38	0.067	-0.025	1
		Q2	3.84	4	-0.16	0.067	-0.011	5
5	Responsiveness	Q7	3.85	4	-0.15	0.067	-0.010	6
		Q8	3.81	4	-0.19	0.067	-0.013	3
		Q12	3.81	4	-0.19	0.067	-0.013	4

$$\text{Overall GAP Score} = \frac{\text{Sum of Total Servqual}}{\text{Sum of Atribute}} = \frac{-0.113}{15} = -0.008$$

$$\frac{15}{15}$$

Based on the above calculation, the level of service quality is -0.008, which means that the customer still perceives service quality negatively and has not been in accordance with the expectations of the customer.

There are 10 statements that get negative Gap values. The overall improvement proposal can be seen in Table 3.

TABLE 3. Proposed Overall Improvement

Number	Code	The Basis of the Proposal	Proposal	Control
1	Q6	Convenience Agent to contact both face to face and by telephone	Agents want to spend time when customers want to meet or call	Give reward and punishment to those concerned
2	Q3	Clarity of time estimation from Agent to a service process	Agents provide clarity of time estimates responsibly	Give reward and punishment to those concerned
3	Q8	Availability of agent time in serving you	Agents want to spend time when customers ask for help	Give reward and punishment to those concerned
4	Q12	Agent's ability to understand your needs & desires	Increase the experience of being an agent and communicating with customers	Give reward and punishment to those concerned
5	Q2	Speed & alertness of agents in providing responses / responses	Agents are more disciplined in giving responses / responses	Give reward and punishment to those concerned

**TABLE 3.** Proposed Overall Improvement

Number	Code	The Basis of the Proposal	Proposal	Control
6	Q7	Agent's ability to listen to your needs & desires	Agents want to listen to problems and customer insurance needs	Give reward and punishment to those concerned
7	Q10	Agent's ability to resolve requests & problems	Increase the experience of being an agent and communicating with customers	Give reward and punishment to those concerned
8	Q13	Complete tools, documents or Agent tools when serving you	Always up to date with technology	Provide equipment, documents needed by the agent
9	Q15	Your trust in agents for long-term service	Agents always help and maintain good relationships with customers	Give reward and punishment to those concerned
10	Q11	Knowledge & skills of agents in the field of insurance financial services	Increase experience and diligently attend training from the company	Give reward and punishment to those concerned

### Data Mining Classification-Decision Tree

Preprocessing the data used in the form of categorizing the ages from numbers to young, middle and old; old categorization of customers from numbers to new, medium and long; and giving a satisfied statement provided that the value of reality > expectation value.

Gain value is obtained from the value of entropy. After getting the gain value of each attribute for node 1, the largest gain value is chosen where the attribute of the gain value will be the root of the next node. This process is carried out until 1 final attribute is left. The following is an example of calculating the entropy value in total entropy[10]:

$$\text{Total Entropy} = \left( -\frac{90}{100} \times \log_2 \frac{90}{100} \right) + \left( -\frac{10}{100} \times \log_2 \frac{10}{100} \right) = 0.4689955936$$

The following is an example of calculating the gain value at node 1:

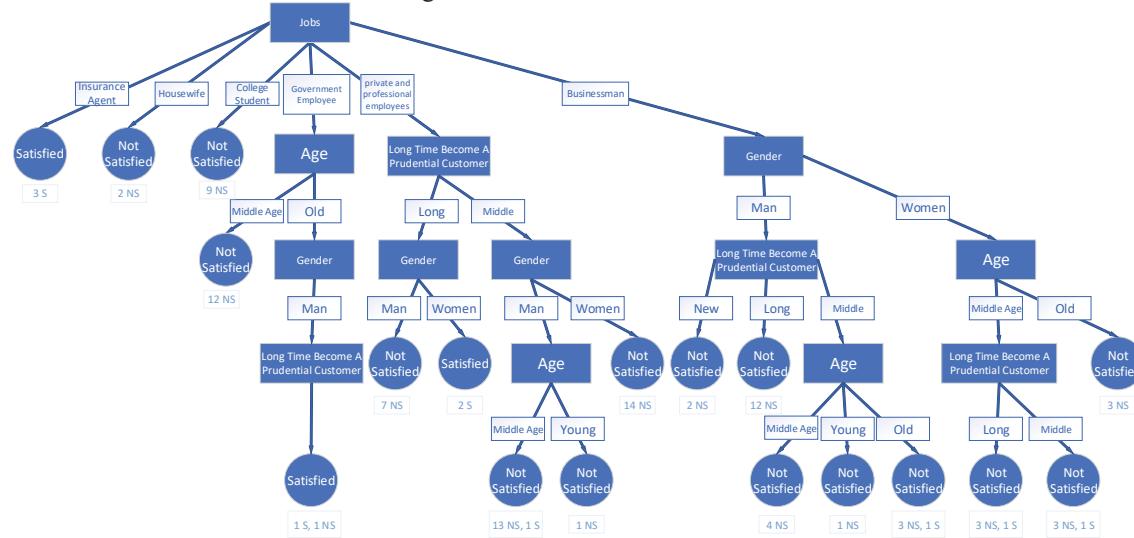
$$\text{Gain} = 0.4689955936 - \left[ \left( \frac{59}{100} \times 0.4743454376 \right) + \left( \frac{41}{100} \times 0.461216041 \right) \right] = 0.000033208811$$

An example of the calculation of entropy and gain values can be seen in Table 4.

**TABLE 4.** Examples of Calculation of Entropy and Gain Values

Node	Attribute	Value	Total of Cases	No	Yes	Entropy	Gain
1	Total Gender		100	90	10	0.468995594	3.32088E-05
	Age	Man	59	53	6	0.474345438	
		Women	41	37	4	0.461216041	0.001765135
	Job	Young	13	12	1	0.391243564	
		Middle Age	63	56	7	0.503258335	
		Old	24	22	2	0.41381685	0.119220909
	Long Time Being a Prudential Customer	Private and Professional Employees	38	35	3	0.398459274	
		Government Employees	14				
		Insurance Agent	3	13	1	0.371232327	
		College Student	9				
		Businessman	31	0	3	0	
		Housewife	2	9	0	0	0.030397505
		New	11	11	0	0	
		Middle	53	49	4	0.386018901	
		Long	36	30	6	0.650022422	

Decision tree results of Rapidminer Studio software are the same as manual calculation decision trees. The results of the decision tree can be seen in Figure 3.



**FIGURE 3.** Decision Tree

The results of the decision tree can be translated into if then rule. An example of if then rule in the type of work of private employees can be seen in Table 5.

**TABLE 5.** If Then Rules for Private & Professional Employee Jobs

No	If Then Rule
1	<p>If the type of job is Private &amp; Professional</p> <p>Long Time Become A Prudential Customer is Middle</p> <p>Gender is man,</p> <p>Age is young</p> <p>Then the level of satisfaction is not satisfied</p>
2	<p>If the type of job is Private &amp; Professional Employees</p> <p>Long Time Become A Prudential Customer is Middle</p> <p>Gender is man</p> <p>Age is Middle</p> <p>Then the level of satisfaction is not satisfied</p>
3	<p>If the type of work is Private &amp; Professional Employees</p> <p>Long Time Become A Prudential Customer is Middle</p> <p>Gender is woman</p> <p>Then the level of satisfaction is not satisfied</p>
4	<p>If the type of work is Private &amp; Professional Employees</p> <p>Long Time Become A Prudential Customer is Long</p> <p>Gender is male</p> <p>Then the level of satisfaction is not satisfied</p>
5	<p>If the type of work is Private &amp; Professional Employees</p> <p>Long Time Become A Prudential Customer is Long</p> <p>Gender is female</p> <p>Then the level of satisfaction is satisfied</p>

## CONCLUSION

1. The level of customer satisfaction in the fuzzy-servqual and data mining methods has a negative value, which means that the services provided by ov agency are still not in line with customer expectations.
2. From the measurements made using the fuzzy-servqual method, the overall gap value is -0.008. The biggest gap value is in the dimension of empathy with a value of -0.025 followed by a dimension of reliability of -0.021, the dimension of responsiveness with a value of -0.013, a physical dimension with a value of -0.007 and a guarantee of -0.004. Of the 15 questionnaire questions, there were 10 questions that received negative gap values, namely the convenience of agents to contact (q6), clarity of estimated service time (q3), availability of agent time to serve (q8), agent ability to understand customer needs and desires (q12), the speed and alertness of the agent responds (q2), the ability of the agent to listen to customer needs (q7), the ability of the agent to resolve requests and problems (q10), completeness of tools, documents or agent tools (q13), customer trust to the agent for long-term service (q15), knowledge and skills of agents in the field of insurance financial services (q11).
3. From data mining method, it is concluded that there are 2 types of unsatisfied work, namely customers who have jobs as housewives and students. Customers who have jobs as insurance agents are satisfied with the services provided. The other 3 types of work have both perceptions of satisfaction and dissatisfaction, namely customers who have jobs as private and professional employees, civil servants / bumn / bumd, and entrepreneurs.

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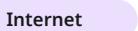
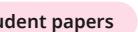
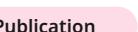
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# Proposed Development Process to Improve Customer Quality of Service with Fuzzy-Servqual and Data Mining Methods in Insurance Agency

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**Abstract.** This study aims to measure and analyze customer satisfaction with the services provided by OV Agency agents. The data used in the study are questionnaires filled by 100 random customers from OV Agency. The study used the Fuzzy-ServQual method and data mining with the Classification-Decision Tree algorithm. Fuzzy-ServQual is used to measure attributes that need to be improved based on the calculation of GAP values with the addition of fuzzy methods to eliminate the obscurity obtained from the results of the questionnaire. The Data Mining Classification Method was used to determine hidden patterns by a decision tree. The results of the calculation of the overall GAP value on the Fuzzy-ServQual method are -0.008 and there are 10 attributes that require improvement. Decision trees are using the Rapid Minner Studio application. Based on the decision tree obtained, if then rule can be obtained as a pattern of satisfaction and dissatisfaction.

**Keywords:** Service Quality, Fuzzy-ServQual, Data Mining, Classification-Decision Tree

## INTRODUCTION

Companies in the service sector are required to improve service quality to increase high global competition. The research is in insurance company. This study aims to analyze agent services to customers using the Fuzzy-ServQual method and Classification-Decision Tree Data Mining.

OV agency gets customer dissatisfaction regarding the services provided by agents. This can be caused by the lack of commitment of the agents in explaining insurance products and reminding clients to pay the premium. In addition, the standard and quality of marketing and service between OV agency agents are not uniform. With the decrease in the level of customer satisfaction with the performance of sales agents, it can reduce the productivity of OV agency.

This study aims to improve the quality of customer service which can be described as follow to know the level of customer satisfaction with the performance of OV agency sales agents, to analyze the calculation of Gap values from the questionnaire and providing suggestions for improving customer service quality using the Fuzzy-ServQual method, to analyze the classification and provide suggestions for improving customer service quality using the Classification-Decision Tree Data Mining method.

Sampling technique is a technique in sampling that will be used in research. The sample is part of the number and characteristics possessed by the study population [1]. Determining the number of samples that is most appropriate to use in research depends on the level of accuracy / desired error. The greater the level of error, the smaller the number of samples needed, and conversely the smaller the level of error, the greater the number of samples needed. Determine the number of samples with a 5% error rate based on the Isaac Michael formula as follows:

$$s = \frac{\lambda^2 \cdot N \cdot P \cdot Q}{d^2(N-1) + \lambda^2 \cdot P \cdot Q} \quad (1)$$

Information:

s = number of samples

$\lambda$  = degree of trust

N = population

d = degree of error

P = proportion of target population (50%)

Q = proportion of target population (50%)

There are many research about quality service. Customer satisfaction is the key to creating customer loyalty. Many benefits are received by the company by achieving a high level of customer satisfaction, which is in addition to increasing customer loyalty but can also prevent customer turnover, reduce customer sensitivity to prices, reduce marketing failure costs, reduce operating costs caused by increasing numbers of customers, increase advertising effectiveness, and improve business reputation [2].

There are many research about fuzzy servqual. The study of the quality of service by the patient BPJS Health, the highest gap value is the empathy dimension and the lowest gap is the dimension of tangibles (physical proof) thus it can be seen that the dimensions of tangibles (physical evidence) is of concern to improve service quality [3]. The research that measured the service quality by using Fuzzy Servqual by determining the gap between expectations with consumer perception, determining the level of significance between expectations with consumer perceptions, determining the level of service quality and suggesting improvement based on priority by looking at the gap of each quality dimension. Based on the results of data processing, it can be seen that the level of service quality is still low seen from the value of Q t-table[4]. The research evaluated the quality of a large hotel through the fuzzy SERVQUAL and fuzzy AHP. The results showed that the services have many gaps to be improved.[4]

The classification process is a complex technique that connects language, text, information and knowledge theories with computational formalisation, statistical and symbolic approaches, standard and non-standard logics, etc. The propose in this paper a formal model with strong logical foundations based on applicative type systems.[5]

The previous research and the research position can be seen in Table 1.

TABLE 1. Research Position

NO	METHOD	SOURCE
1	Integration of quality service, customer satisfaction, Customer Loyalty, non-probability purposive sampling technique, Structural Equation Modeling	[2]
2	Integration between Fuzzy and Servqual	[3]
3	Integration between the fuzzy SERVQUAL and fuzzy AHP	[4]
4	Integration between classification, applicative systems, collaborative intelligent science	[5]
5	Data Mining classification methods: decision tree (J48), neural Network (MLP) and naive Bayes	[6]
6	Integration between Fuzzy, Quality Function Deployment, and Data Mining	[7]
7	Integration between Six Sigma, FMEA, and Data Mining	[8]
8	Integration between SERVQUAL, Analytical Hierarchy Process (AHP) and Citizen's Score Card	[9]
9	Integration SERVQUAL, service quality, safety concerns and maintenance	[10]
10	Integration between Fuzzy, Servqual, Data Mining	This research position

The position of this research among other studies around the world, can be seen from various aspects above. Can be seen from the aspect of Quality Control research methodology is a combination of fuzzy and method of Servqual, where Servqual is applied simultaneously with fuzzy logic to reduce the subject subjectivity of respondents. Data mining method is also used to know the classification of satisfaction level on OV Agency

## RESEARCH METHODOLOGY

The flow of the research methodology can be seen in Figure 1. The results of processing Fuzzy-ServQual methods and Data Mining Classification-Decision Tree. From data processing using the ServQual method, the output value gap is obtained which indicates satisfaction of customers' dissatisfaction with the services of the agents. In the Data Mining method Classification-Decision Tree is expected to output is a decision tree-shaped classification that can be used to make an if then rule. The results of the analysis obtained are used as a reference for making proposals.

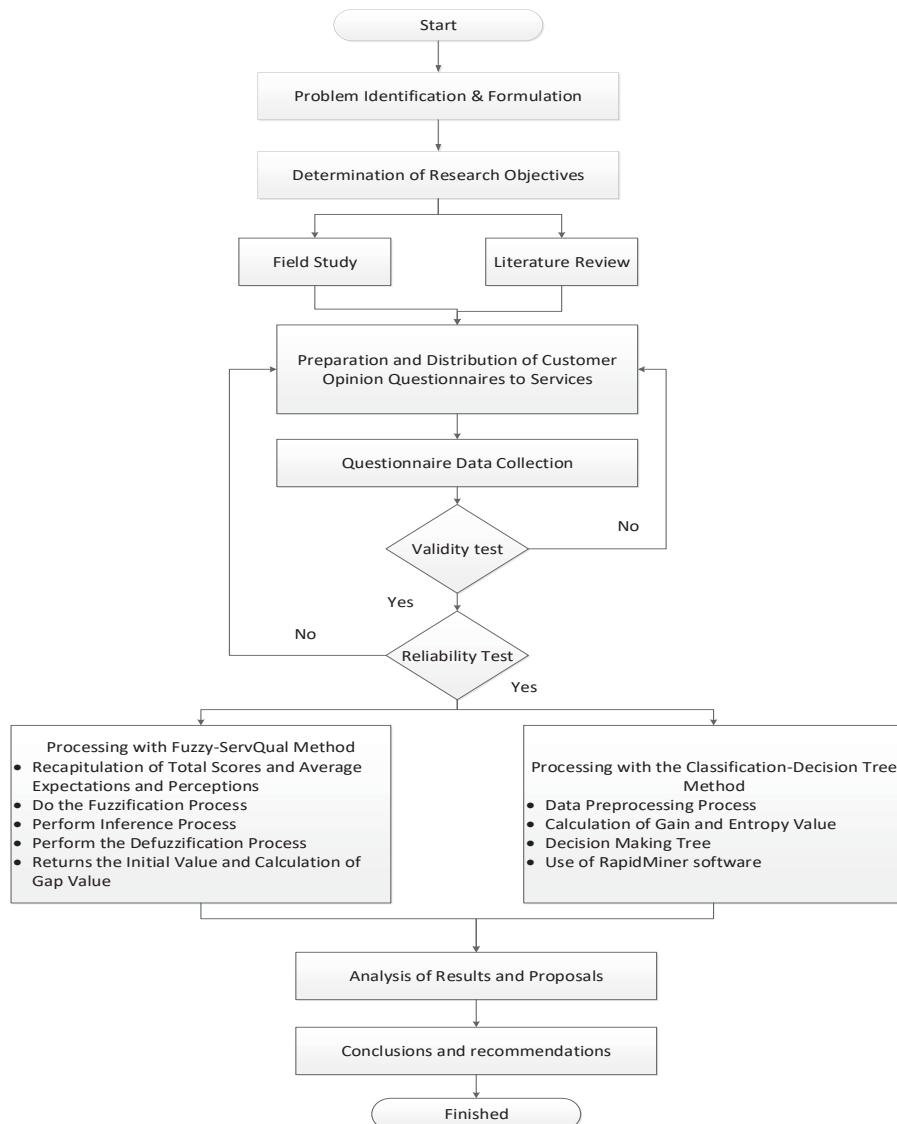


FIGURE 1. Research Methodology Flowchart

## RESULTS AND DISCUSSION

Determining the number of samples that is most appropriate to use in research depends on the level of accuracy / desired error. The greater the level of error, the smaller the number of samples needed, and conversely the smaller the level of error, the greater the number of samples needed. Determine the number of samples with a level of error of 5% based on the isaac michael formula as follows:

$$s = \frac{0.95^2 \times 12000 \times 0.5 \times 0.5}{0.05^2 (12000 - 1) + 0.95^2 \times 0.5 \times 0.5} = 89.583 \approx 90$$

Through the above calculations, it was found that the number of sample questionnaires needed was 90 respondents, and rounded up to 100 respondents on the google form.

Respondents' demographics are an important factor in seeing market segmentation, and based on these demographics, it can be seen how the behavior of the consumers studied.

In this study, by the SPSS, 25 program was used in testing validity. Tests were carried out 2 times, namely for the results of the questionnaire questions, the perceptions and questions of respondents' expectations of the performance and service of the OV agency agents.

The validity test calculation uses the value of the table with a 2-way test and a significance level of 5%. The value of freedom degree (dF) is obtained using calculation (dF) = N-2 with N = 100. The results of calculation of degrees of freedom (dF) are 98 with table value = 0.1966. Data is declared valid if the calculated value is greater than the table value. A variable is said to be reliable if it gives an alpha cronbach value > 0.60. After calculating using SPSS 25, the Cronbach alpha value for perception is 0.905 and the Cronbach alpha value for expectation is 0.830. Based on the results of calculations, questionnaire data can be concluded for reliable perceptions and expectations.

## Fuzzy-ServQual Method

The first step is to calculate the value of the total score of perception and expectation. The following is a sample calculation of total scores and average scores for questions of perception and expectation.

1. Calculation of question number 3 (Q3) part of perception

$$\text{Total Score} = (0 \times 1) + (7 \times 2) + (32 \times 3) + (46 \times 4) + (15 \times 5) = 369$$

$$\text{Average Score} = 369/100 = 3.69$$

2. Calculation of question number 3 (Q3) part of hope

$$\text{Total Score} = (0 \times 1) + (0 \times 0) + (8 \times 3) + (39 \times 4) + (53 \times 5) = 445$$

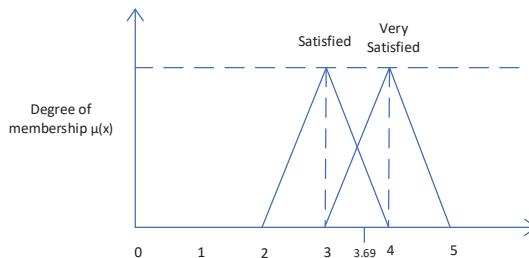
$$\text{Average score} = 445/100 = 4.45$$

The next stage is the fuzzification calculation of the questionnaire questions of perception and expectation [9]. The following are examples of fuzzification calculations from questions of perception and expectation number 3 (Q3).

1. Question number 3 (Q3) Perception

Based on the calculation of the average total score obtained x value of 3.69. Then the fuzzification calculation is as follows:

- Satisfied and Very Satisfied Categories
- Membership function



**FIGURE 2.** Graph of Fuzzy Set Questions Number 3 (Q3) Perception

Fuzzy Set function is in the satisfied and very satisfied category because x = 3.69.

2. Question Number 3 (Q3) Hope

Based on the calculation of the average total score obtained x value of 4.45. Then the fuzzification calculation is as follows:

- Very Satisfied Category
- Membership function
- Fuzzy Set function

Because x = 4.45 and the classification is very satisfied then

$$\mu_{\text{very satisfied}}(4,45, 3, 4, 5) = \frac{5 - 4,45}{5 - 4} = 0,55 \text{ for } 4 < x < 5$$

5-4

The inference process is the reasoning used based on the composition of the min. This process consists of determining the rules of the bounding value of each set in each variable and determining the predicate value.

$$Y^* = \frac{\sum(yi * wi)}{\sum wi} \quad (2)$$

After defuzzification results for each question attribute, the next step is to determine the ServQual value by determining the gap value, determining the weight and determining the weighted gap which is the final result of the ServQual score. To determine the gap value the formula is used:

$$\text{Gap} = \text{Performance} - \text{Hope} \quad (3)$$

While the weight value is obtained from the number of attribute questions that exist. Because the questions amount to 15 each questionnaire, the weight values are:

$$\text{Weight} = 1/15 = 0.067$$

Then, the next step is to determine the weighted gap which is the final ServQual score using the approach:

$$\text{ServQual score (weighted gap)} = \text{Gap value} \times \text{Weight} \quad (4)$$

Recapitulation of calculation of ServQual values based on service quality attributes can be seen in Table 2.

**TABLE 2.** Recapitulation of Defuzzification and Value of GAP

Number	Dimension	Code	Defuzzification Perception	Defuzzification Expectation	GAP (P-E)	Weight (1/15)	GAP Weighted	Rank
1	Reliability	Q3	3.69	4	-0.31	0.067	-0.021	2
		Q4	4	4	0	0.067	0.000	11
		Q10	3.89	4	-0.11	0.067	-0.007	7
		Q11	3.96	4	-0.04	0.067	-0.003	10
2	Assurances	Q9	4	4	0	0.067	0.000	12
		Q15	3.94	4	-0.06	0.067	-0.004	9
3	Tangibles	Q13	3.89	4	-0.11	0.067	-0.007	8
		Q14	4	4	0	0.067	0.000	13
		Q1	4	4	0	0.067	0.000	14
4	Empathy	Q5	4	4	0	0.067	0.000	15
		Q6	3.62	4	-0.38	0.067	-0.025	1
		Q2	3.84	4	-0.16	0.067	-0.011	5
5	Responsiveness	Q7	3.85	4	-0.15	0.067	-0.010	6
		Q8	3.81	4	-0.19	0.067	-0.013	3
		Q12	3.81	4	-0.19	0.067	-0.013	4

$$\text{Overall GAP Score} = \frac{\text{Sum of Total Servqual}}{\text{Sum of Atribute}} = \frac{-0.113}{15} = -0.008$$

$$\frac{15}{15}$$

Based on the above calculation, the level of service quality is -0.008, which means that the customer still perceives service quality negatively and has not been in accordance with the expectations of the customer.

There are 10 statements that get negative Gap values. The overall improvement proposal can be seen in Table 3.

**TABLE 3.** Proposed Overall Improvement

Number	Code	The Basis of the Proposal	Proposal	Control
1	Q6	Convenience Agent to contact both face to face and by telephone	Agents want to spend time when customers want to meet or call	Give reward and punishment to those concerned
2	Q3	Clarity of time estimation from Agent to a service process	Agents provide clarity of time estimates responsibly	Give reward and punishment to those concerned
3	Q8	Availability of agent time in serving you	Agents want to spend time when customers ask for help	Give reward and punishment to those concerned
4	Q12	Agent's ability to understand your needs & desires	Increase the experience of being an agent and communicating with customers	Give reward and punishment to those concerned
5	Q2	Speed & alertness of agents in providing responses / responses	Agents are more disciplined in giving responses / responses	Give reward and punishment to those concerned

**TABLE 3.** Proposed Overall Improvement

Number	Code	The Basis of the Proposal	Proposal	Control
6	Q7	Agent's ability to listen to your needs & desires	Agents want to listen to problems and customer insurance needs	Give reward and punishment to those concerned
7	Q10	Agent's ability to resolve requests & problems	Increase the experience of being an agent and communicating with customers	Give reward and punishment to those concerned
8	Q13	Complete tools, documents or Agent tools when serving you	Always up to date with technology	Provide equipment, documents needed by the agent
9	Q15	Your trust in agents for long-term service	Agents always help and maintain good relationships with customers	Give reward and punishment to those concerned
10	Q11	Knowledge & skills of agents in the field of insurance financial services	Increase experience and diligently attend training from the company	Give reward and punishment to those concerned

### Data Mining Classification-Decision Tree

Preprocessing the data used in the form of categorizing the ages from numbers to young, middle and old; old categorization of customers from numbers to new, medium and long; and giving a satisfied statement provided that the value of reality > expectation value.

Gain value is obtained from the value of entropy. After getting the gain value of each attribute for node 1, the largest gain value is chosen where the attribute of the gain value will be the root of the next node. This process is carried out until 1 final attribute is left. The following is an example of calculating the entropy value in total entropy[10]:

$$\text{Total Entropy} = \left( -\frac{90}{100} \times \log_2 \frac{90}{100} \right) + \left( -\frac{10}{100} \times \log_2 \frac{10}{100} \right) = 0.4689955936$$

The following is an example of calculating the gain value at node 1:

$$\text{Gain} = 0.4689955936 - \left[ \left( \frac{59}{100} \times 0.4743454376 \right) + \left( \frac{41}{100} \times 0.461216041 \right) \right] = 0.000033208811$$

An example of the calculation of entropy and gain values can be seen in Table 4.

**TABLE 4.** Examples of Calculation of Entropy and Gain Values

Node	Attribute	Value	Total of Cases	No	Yes	Entropy	Gain
1	Total Gender		100	90	10	0.468995594	3.32088E-05
	Age	Man	59	53	6	0.474345438	
		Women	41	37	4	0.461216041	0.001765135
	Job	Young	13	12	1	0.391243564	
		Middle Age	63	56	7	0.503258335	
		Old	24	22	2	0.41381685	0.119220909
	Long Time Being a Prudential Customer	Private and Professional Employees	38	35	3	0.398459274	
		Government Employees	14				
		Insurance Agent	3	13	1	0.371232327	
		College Student	9				
		Businessman	31	0	3	0	
		Housewife	2	9	0	0	0.030397505
		New	11	11	0	0	
		Middle	53	49	4	0.386018901	
		Long	36	30	6	0.650022422	

12

Decision tree results of Rapidminer Studio software are the same as manual calculation decision trees. The results of the decision tree can be seen in Figure 3.

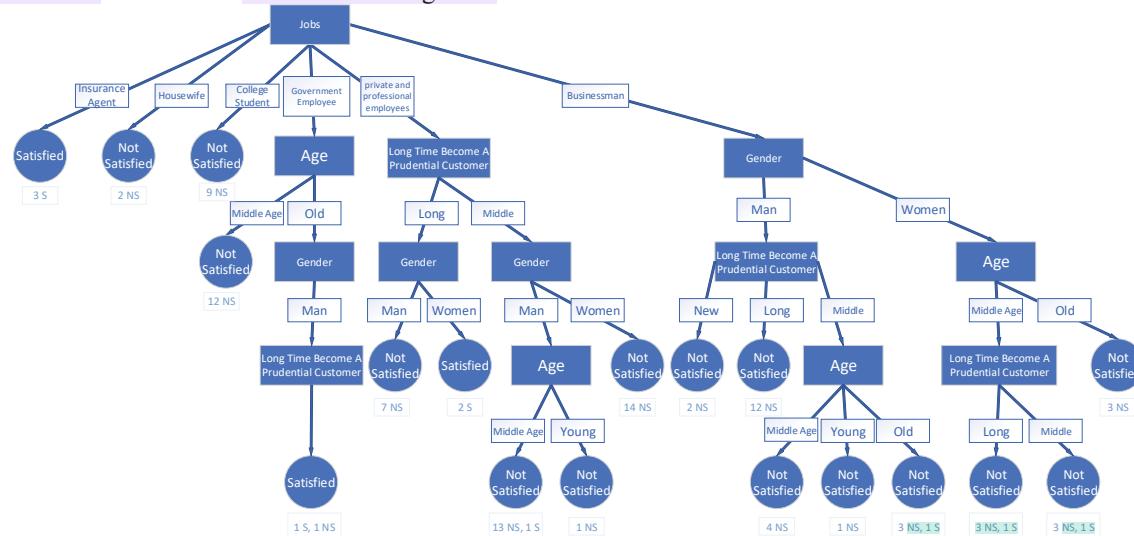


FIGURE 3. Decision Tree

The results of the decision tree can be translated into if then rule. An example of if then rule in the type of work of private employees can be seen in Table 5.

TABLE 5. If Then Rules for Private &amp; Professional Employee Jobs

No	If Then Rule
1	If the type of job is Private & Professional Long Time Become A Prudential Customer is Middle Gender is man, Age is young Then the level of satisfaction is not satisfied
2	If the type of job is Private & Professional Employees Long Time Become A Prudential Customer is Middle Gender is man Age is Middle Then the level of satisfaction is not satisfied
3	If the type of work is Private & Professional Employees Long Time Become A Prudential Customer is Middle Gender is woman Then the level of satisfaction is not satisfied
4	If the type of work is Private & Professional Employees Long Time Become A Prudential Customer is Long Gender is male Then the level of satisfaction is not satisfied
5	If the type of work is Private & Professional Employees Long Time Become A Prudential Customer is Long Gender is female Then the level of satisfaction is satisfied

## CONCLUSION

1. The level of customer satisfaction in the fuzzy-servqual and data mining methods has a negative value, which means that the services provided by ov agency are still not in line with customer expectations.
2. From the measurements made using the fuzzy-servqual method, the overall gap value is -0.008. The biggest gap value is in the dimension of empathy with a value of -0.025 followed by a dimension of reliability of -0.021, the dimension of responsiveness with a value of -0.013, a physical dimension with a value of -0.007 and a guarantee of -0.004. Of the 15 questionnaire questions, there were 10 questions that received negative gap values, namely the convenience of agents to contact (q6), clarity of estimated service time (q3), availability of agent time to serve (q8), agent ability to understand customer needs and desires (q12), the speed and alertness of the agent responds (q2), the ability of the agent to listen to customer needs (q7), the ability of the agent to resolve requests and problems (q10), completeness of tools, documents or agent tools (q13), customer trust to the agent for long-term service (q15), knowledge and skills of agents in the field of insurance financial services (q11).
3. From data mining method, it is concluded that there are 2 types of unsatisfied work, namely customers who have jobs as housewives and students. Customers who have jobs as insurance agents are satisfied with the services provided. The other 3 types of work have both perceptions of satisfaction and dissatisfaction, namely customers who have jobs as private and professional employees, civil servants / bumn / bumd, and entrepreneurs.

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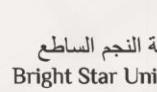
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