

TECHNOLOGY, SUSTAINABILITY, AND BUSINESS INNOVATION:

Evidence from Energy,
Digital Transformation,
and Marketing Studies



Edited by _____
Prof. Dr. Teena SINGH



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Technology, Sustainability, and Business Innovation: Evidence from Energy Systems, Digital Transformation, and Marketing Studies



Editor

Prof. Dr. Teena SINGH

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PREFACE

Technological advancement, sustainability, and business innovation have become essential drivers of organizational and industrial transformation in an increasingly dynamic global environment. As industries face rapid digitalization, environmental challenges, and evolving market expectations, interdisciplinary research offers valuable insights into developing innovative, sustainable, and competitive solutions. This volume, *Technology, Sustainability, and Business Innovation: Evidence from Energy, Digital Transformation, and Marketing Studies*, brings together diverse empirical and conceptual studies that reflect these emerging priorities.

The chapters explore a broad spectrum of contemporary issues across energy systems, business management, digital transformation, marketing, and sustainability. Several contributions focus on petroleum engineering, particularly enhanced oil recovery (EOR), investigating surfactant technologies, completion fluids, rheological properties, adsorption behavior, and laboratory-based recovery analyses. These studies contribute to improving resource efficiency and advancing sustainable energy production.

Complementing the engineering perspective, the volume also examines business innovation through research on digital transformation, digital leadership, affiliate marketing, strategic positioning, creative design processes, and consumer behavior. Other chapters address sustainability from organizational and societal perspectives, including sustainable entrepreneurship, sustainable organizational culture, and environmental solutions for clean water management.

By integrating evidence from multiple disciplines, this book highlights the importance of collaboration between technological innovation, sustainable development, and business strategy. It is intended for researchers, graduate students, professionals, and policymakers seeking evidence-based perspectives on addressing complex industrial and organizational challenges. We hope this volume will stimulate further interdisciplinary research and contribute to both academic knowledge and practical decision-making in support of a more innovative and sustainable future.

Prof. Dr. Teena SINGH

July 2026

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CHAPTER 1

Comparative Literature Study on the Effect of Salinity on Recovery Factor in Core Flooding Tests Using Palm Oil MES Surfactant and 96% Ethanol on 33°API Light Crude Oil

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ABSTRACT

Petroleum production in Indonesia faces major challenges due to declining reservoir pressure and high residual oil saturation after conventional recovery methods. Therefore, chemical Enhanced Oil Recovery (EOR), particularly surfactant flooding, has become an important alternative to improve oil recovery. This study evaluates the effect of NaCl brine salinity on interfacial tension (IFT) reduction and recovery factor (RF) in 33°API light crude oil using a palm oil-based Methyl Ester Sulfonate (MES) surfactant combined with 96% ethanol as a co-surfactant. The research applies a comparative literature study based on laboratory data obtained from a Spinning Drop Tensiometer and Core Flooding Apparatus. Core flooding experiments were conducted on Berea Sandstone samples at 60°C and 100 psig under two formulation conditions: Sample A (7,500 ppm salinity, 1.25% MES + 96% ethanol) and Sample B (12,500 ppm salinity, 1% MES + 96% ethanol). The results show that Sample A produced the lowest IFT value of 0.457 dyne/cm and the highest total recovery factor of 77.09%, while Sample B resulted in a higher IFT of 0.466 dyne/cm and a lower recovery factor of 50%. The study concludes that moderate salinity conditions are more effective in optimizing MES surfactant performance, while ethanol plays an important role in maintaining phase stability and preventing surfactant precipitation at higher salinity conditions.

Keywords: Enhanced Oil Recovery (EOR), Chemical Flooding, Palm Oil Methyl Ester Sulfonate (MES), IFT, Recovery Fac.

INTRODUCTION

Indonesia remains one of the major oil-producing countries in Southeast Asia; however, many mature oil fields are experiencing a significant decline in production due to decreasing reservoir pressure and high residual oil saturation after primary and secondary recovery processes. Conventional recovery methods typically leave a substantial amount of oil trapped within reservoir pores because of capillary forces and unfavorable mobility ratios. As a result, Enhanced Oil Recovery (EOR) technologies have become increasingly important to maximize hydrocarbon recovery and extend the productive life of mature reservoirs.

Among various EOR techniques, chemical EOR has attracted considerable attention because of its ability to improve microscopic displacement efficiency. Surfactant flooding is one of the most widely studied chemical EOR methods due to its capability to reduce the interfacial tension (IFT) between oil and water, thereby mobilizing residual oil trapped within pore spaces. The effectiveness of surfactant flooding depends on several factors, including surfactant type, concentration, reservoir temperature, brine salinity, and the presence of co-surfactants.

Methyl Ester Sulfonate (MES), an anionic surfactant derived from vegetable oils such as palm oil, has emerged as a promising alternative for EOR applications. MES offers several advantages, including biodegradability, environmental compatibility, and relatively low production costs compared with conventional petroleum-based surfactants. In addition, the use of alcohol-based co-surfactants, such as ethanol, can enhance surfactant performance by improving phase behavior, increasing solubility, and preventing surfactant precipitation under varying salinity conditions.

Salinity is a critical parameter influencing surfactant performance during chemical flooding operations. The interaction between surfactant molecules and dissolved salts can significantly affect interfacial tension reduction, adsorption behavior, phase stability, and ultimately oil recovery efficiency. While moderate salinity may improve surfactant activity and optimize microemulsion formation, excessive salinity can lead to reduced effectiveness due to surfactant precipitation and unfavorable phase behavior. Therefore, determining the optimal salinity condition is essential for achieving maximum EOR performance.

This study investigates the effect of NaCl brine salinity on the performance of a palm oil-based MES surfactant combined with 96% ethanol as a co-surfactant in recovering 33°API light crude oil. The evaluation focuses on the relationship between salinity, interfacial tension reduction, and recovery factor through comparative analysis of laboratory measurements using a Spinning Drop Tensiometer and Core Flooding Apparatus. Two surfactant formulations with different salinity conditions were tested using Berea Sandstone cores under controlled temperature and pressure conditions. The findings of this study are expected to contribute to the optimization of surfactant formulations for chemical EOR implementation in Indonesian oil fields and other reservoirs with similar characteristics.

2. MATERIALS & METHODOLOGY

2.1 Material

The materials used in this study consisted of :

- Light crude oil with an API gravity of 33°API.
- Methyl Ester Sulfonate (MES) surfactant derived from palm oil.
- Ethanol 96% as a co-surfactant.
- Sodium chloride (NaCl) brine solution.
- Berea Sandstone core samples.

Two surfactant formulations were prepared as follows:

Sample A :

- Salinity: 7,500 ppm
- MES concentration: 1.25%
- Ethanol concentration: 96%

Sample B :

- Salinity: 12,500 ppm NaCl
- MES concentration: 1.00 wt%
- Ethanol concentration: 96%.

2.2 Methodology

This study employed an experimental laboratory approach to evaluate the effect of NaCl brine salinity on the performance of a palm oil-based Methyl Ester Sulfonate (MES) surfactant combined with 96% ethanol as a co-surfactant for Enhanced Oil Recovery (EOR) applications. The performance evaluation was conducted through interfacial tension (IFT) measurements and core flooding experiments to determine the recovery factor (RF) under different salinity conditions.

2.2.1 Interfacial Tension Measurement

Interfacial tension measurements were conducted using a Spinning Drop Tensiometer. The objective of this test was to determine the ability of each surfactant formulation to reduce the interfacial tension between crude oil and the aqueous surfactant solution.



Figure III. 1 Spinning drop tensiometer

The testing procedure consisted of the following steps:

- The surfactant solutions were prepared according to the specified salinity and concentration conditions.
- The sample crude of the Spinning Drop Tensiometer was filled with the surfactant solution.
- A small droplet of crude oil was injected into the rotating capillary tube containing the surfactant solution.
- The instrument was operated at a predetermined rotational speed until the oil droplet reached equilibrium.
- The dimensions of the elongated oil droplet were recorded and analyzed using the instrument software.
- The interfacial tension value was calculated based on the Vonnegut equation.
- Measurements were conducted at a temperature of 60°C to simulate reservoir conditions.

The obtained IFT values were used to evaluate the effectiveness of each surfactant formulation.

2.2.2 Core Flooding Apparatus

Core flooding tests were performed using a Core Flooding Apparatus to evaluate the oil displacement efficiency and recovery factor of each surfactant formulation.



Figure III. 2 Core flooding apparatus

The testing core preparation procedure consisted of the following steps:

- Berea Sandstone core samples were cleaned and dried to remove residual fluids.
- Core dimensions, dry weight, and porosity characteristics were determined.
- The core samples were vacuum-saturated with NaCl brine solution.
- Initial water saturation (S_{wi}) was established.
- Crude oil was injected into the core until irreducible water saturation (S_{wi}) was achieved.

The testing flooding procedure consisted of the following steps:

The flooding experiments were conducted at a temperature of 60°C and a pressure of 100 psig.

The experimental sequence included:

- Water Flooding Stage
 - Brine was injected continuously into the core holder.
 - Oil production was recorded until no additional oil was produced.
 - The recovery factor after water flooding was calculated.
- Surfactant Flooding Stage
 - The prepared surfactant solution was injected into the core after water flooding.
 - The injected volume was maintained at a predetermined flow rate.
 - Produced fluids were collected and separated.
 - Incremental oil recovery resulting from surfactant injection was measured.
- Post-Flush Stage
 - Additional brine was injected to displace the remaining surfactant solution and mobilized oil.
 - Final oil production data were recorded.

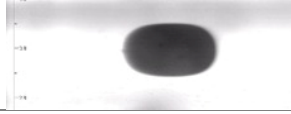
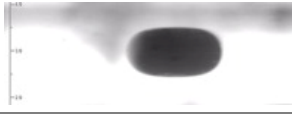
3. RESULT AND DISCUSSION

This chapter presents the laboratory analysis results regarding the effect of NaCl brine salinity variations on the performance of palm oil-based Methyl Ester Sulfonate (MES) surfactant combined with 96% ethanol as a co-surfactant.

3.1 Interfacial tension (IFT) analysis

The effectiveness of surfactant flooding is strongly influenced by its ability to reduce the interfacial tension (IFT) between crude oil and the injected aqueous phase. Lower IFT values reduce capillary forces that trap residual oil within reservoir pore spaces, thereby improving oil mobilization and displacement efficiency. The IFT measurements obtained using the Spinning Drop Tensiometer are presented in Table 3.1

Table 3. 1 Interfacial tension result

Sample	Salinity (ppm)	MES (%)	IFT (dyne/cm)	Picture
A	7,500	1.25	0.457	
B	12,500	1	0.466	

The utilization of nitrate salt as a base brine is specifically selected for its capability to achieve high fluid density through its remarkably high solubility within the aqueous phase. In its baseline state (Table 3.1), this base brine can reach a Specific Gravity (SG) of 1.686 (~1.7) without employing solid weighting agents, rendering it completely solids-free (unlike conventional systems using barite). This solids-free characteristic of the nitrate salt is highly critical during the completion phase to eliminate the risk of mechanical plugging within the pores of productive formations or sand screens.

The results indicate that Sample A produced the lowest IFT value of 0.457 dyne/cm, whereas Sample B yielded a slightly higher IFT value of 0.466 dyne/cm. Although the difference appears relatively small, it demonstrates the influence of salinity on surfactant performance. At a salinity of 7,500 ppm, the MES surfactant exhibited better interfacial activity, allowing surfactant molecules to adsorb more effectively at the oil-water interface. This behavior enhanced the reduction of interfacial tension and improved the potential for residual oil mobilization. Conversely, increasing salinity to 12,500 ppm reduced the effectiveness of the surfactant solution. High concentrations of dissolved salts can alter the electrostatic interactions between surfactant molecules, potentially reducing their ability to stabilize the oil-water interface. Excessive salinity may also increase the tendency of surfactant aggregation and precipitation, leading to less efficient IFT reduction.

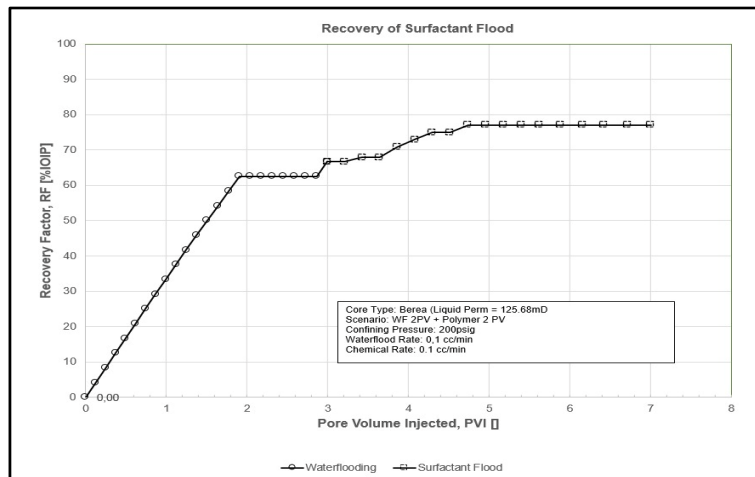
3.2 Recovery factor analysis

Core flooding experiments were conducted to evaluate the effect of surfactant performance on oil recovery. The recovery factors obtained from Berea Sandstone core samples are summarized in Table 3.2

Table 3. 2 Recovery factor result

Sample	Salinity (ppm)	Total Recovery Factor (%)
A	7,500	77.09
B	12,500	50

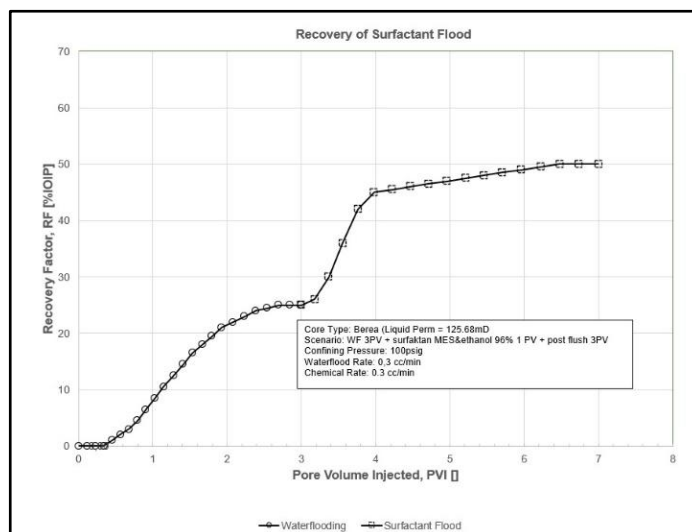
The experimental results show that Sample A achieved the highest total recovery factor of 77.09%, while Sample B produced a significantly lower recovery factor of 50%. The higher recovery factor observed in Sample A can be attributed to its lower interfacial tension and higher surfactant concentration. The reduction



Picture III. 1 Result core flood sample A

in IFT allowed trapped oil droplets to overcome capillary forces more easily, resulting in improved displacement efficiency during surfactant flooding. Furthermore, the 1.25% MES concentration provided a greater number of active surfactant molecules available to interact with the oil-water interface.

In contrast, Sample B exhibited lower oil recovery despite the presence of ethanol. The combination of higher salinity and lower MES concentration may have reduced the effectiveness of the surfactant system, limiting its ability to mobilize residual oil. The higher ionic strength of the brine likely affected surfactant behavior within the porous media, resulting in less favorable displacement conditions.



Picture III. 2 Result core flood sample B

3.3 Relationship between salinity, interfacial tension, and oil recovery

The results demonstrate a clear relationship between salinity, interfacial tension, and recovery factor. As salinity increased from 7,500 ppm to 12,500 ppm, the IFT increased from 0.457 dyne/cm to 0.466 dyne/cm. This increase in IFT was accompanied by a substantial decrease in recovery factor from 77.09% to 50%.

These findings indicate that optimum salinity conditions are essential for maximizing the performance of MES surfactant flooding. Moderate salinity levels appear to provide a favorable environment for surfactant activity, allowing efficient IFT reduction and improved oil displacement. However, excessive salinity can adversely affect surfactant behavior and reduce overall recovery efficiency.

The results are consistent with the fundamental mechanism of surfactant EOR, where lower interfacial tension leads to lower capillary trapping and increased mobilization of residual oil. Therefore, controlling salinity becomes a critical parameter in designing surfactant formulations for field-scale applications.

3.4 Discussion of practical implications

The findings of this study suggest that MES surfactant formulations perform more effectively under moderate salinity conditions. The formulation containing 1.25% MES and 7,500 ppm NaCl achieved the most favorable balance between interfacial tension reduction and oil recovery efficiency.

For potential field implementation, reservoirs with similar characteristics may benefit from salinity adjustment prior to surfactant injection to achieve optimum surfactant performance. Furthermore, the use of renewable palm oil-derived surfactants such as MES offers a sustainable and economically attractive alternative to conventional synthetic surfactants for future EOR projects in Indonesia.

4. CONCLUSION

This study evaluated the effect of NaCl brine salinity on the performance of a palm oil-based Methyl Ester Sulfonate (MES) surfactant combined with 96% ethanol as a co-surfactant for Enhanced Oil Recovery (EOR) applications. Based on the results obtained from interfacial tension measurements and core flooding experiments, the following conclusions can be drawn:

1. Salinity significantly influences the performance of the MES surfactant system in reducing interfacial tension and improving oil recovery. The formulation with a salinity of 7,500 ppm (Sample A) demonstrated better performance than the formulation with a salinity of 12,500 ppm (Sample B).
2. The lowest interfacial tension value was achieved by Sample A, reaching 0.457 dyne/cm, while Sample B produced a slightly higher value of 0.466 dyne/cm. These results indicate that moderate salinity conditions enhance the interfacial activity of the MES surfactant.
3. Core flooding experiments showed that Sample A generated the highest total recovery factor of 77.09%, whereas Sample B resulted in a recovery factor of 50%..
4. Increasing salinity from 7,500 ppm to 12,500 ppm reduced the overall effectiveness of the surfactant formulation. Higher salinity conditions likely affected surfactant behavior, resulting in less efficient interfacial tension reduction and lower oil recovery.

5. The addition of 96% ethanol as a co-surfactant contributed to maintaining surfactant stability and solubility, helping to prevent surfactant precipitation under varying salinity conditions. However, salinity remained the dominant factor affecting the overall performance of the surfactant system.

Overall, the results demonstrate that a MES surfactant formulation containing 1.25% MES and 7,500 ppm NaCl provides the most favorable performance among the tested conditions. Therefore, optimizing brine salinity is essential to maximize the efficiency of MES-based surfactant flooding for chemical EOR applications in mature oil reservoirs.

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CHAPTER 2

Nature-Based Solutions for Clean Water Crisis Mitigation: Opportunities for Sustainable Entrepreneurship

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ABSTRACT

The Cisadane Watershed is one of the critical watersheds in Central Java, particularly in Purbalingga Regency, which frequently faces flooding during the rainy season. These events often cause damage to infrastructure and agricultural land. The urgency of this research is to understand the distribution of floods and optimal nature-based solution modeling in the downstream of the Cisadane River. This study aims to produce a flood hazard potential map in the downstream area of the Cisadane River and the villages affected by flooding. Assessing the suitability of nature based solutions for flood risk reduction is strongly aligned with Universitas Trisakti's 2020–2030 Research Roadmap, particularly within the domains of Green Urban Environment, Green Healthy Life, Green Society, and Green Engineering Technology. The research methods include literature review, spatial analysis of potential locations for NBS implementation (such as watersheds), and evaluation of the effectiveness of various forms of NBS such as constructed wetlands, biofiltration systems. This research contributes to the sustainable development goals (SDGs 6 and 13). The outcomes of the research are international journal publications, intellectual property rights.

Keywords: Flood, Watershed, Nature Based Solution, Water Crisis, Suitability.

1. 1. Background

The clean water crisis is one of the main challenges in urban areas of Indonesia, including in the Cisadane River Basin (DAS) area, which crosses the regions of Bogor Regency and City, Tangerang Regency and City, and flows into Jakarta Bay. The Cisadane River plays a vital role as a source of raw water for millions of residents, agricultural irrigation, and industrial activities (Maulana & Hidayat, 2024). However, in recent decades, the water quality of this river has continued to decline due to increased anthropogenic activities, such as the disposal of domestic waste, industrial waste, sedimentation, and land use change in the upstream areas and riverbanks. According to data from the Ministry of Environment and Forestry (KLHK), the water quality status of the Cisadane River at several observation points is already in the moderately to heavily polluted category, with concentrations of BOD, COD, TSS, and Total Coliform parameters exceeding Class II water quality standards. This indicates significant environmental pressure on the hydrological system and river ecosystem, which ultimately threatens the clean water security of communities in the downstream areas, particularly in Tangerang City and its surroundings (Yustiani et al., 2021). According to data from the Ministry of Environment and Forestry (KLHK), the water quality status of the Cisadane River at several observation points has already fallen into the moderately to heavily polluted category, with concentrations of BOD, COD, TSS, and Total Coliform parameters exceeding the class II water quality standards. This indicates significant environmental pressure on the hydrological system and river ecosystem, which ultimately threatens the clean water security of communities in the downstream areas, particularly in Tangerang City and its surroundings (Amirzada et al., 2023a). According to data from the Ministry of Environment and Forestry (KLHK), the water quality status of the Cisadane River at several observation points has already fallen into the moderately to heavily polluted category, with concentrations of BOD, COD, TSS parameters. This indicates a significant environmental pressure on the hydrological system and river ecosystem, which ultimately threatens the clean water resilience of communities in downstream areas, particularly in Tangerang City and its surroundings. The application of the NBS concept in the Cisadane River is very relevant considering that this area has a variety of topographical characteristics and complex land use — from upstream areas that still have vegetation cover to densely populated downstream areas (Rahmani, 2024). Therefore, this study is important to identify the potential application and effectiveness of Nature-Based Solutions in mitigating the clean water crisis in the Cisadane watershed, as well as to produce recommendations for adaptive and sustainable nature-based management strategies .

1. 2. Research Objectives

1. To identify existing condition of water quality and land cover along the Cisadane River
2. To assess the potential for applying Nature-Based Solutions elements (constructed wetlands and rain gardens) in the Cisadane watershed area
3. To what extent is the effectiveness of NBS approaches in improving water quality and reducing pollution load in the Cisadane River

1. 3. Scope of Research

1. Study area: Selected segments of the Cisadane River, from upstream to downstream areas.
2. Sampling locations will represent urban, peri-urban, agricultural, and industrial zones.

1. 4. Research Limitations

1. Limited sampling duration and spatial coverage.
2. Focus on selected key water quality parameters.
3. Evaluation of NBS effectiveness based on modeling or pilot-scale assessment rather than long-term implementation.

2. 1. Literature Review

One specific aspect of flood management is the implementation of a Nature-Based Solution (NBS) system, where flood resilience will be addressed comprehensively within a single River Basin (DAS) (Chairat & Gheewala, 2024). The NBS concept for flood management includes all elements within the river basin, namely: handling evapotranspiration, infiltration, water management systems, management of lowland areas, river body treatment, as well as coastal area protection (Amirzada et al., 2023b).

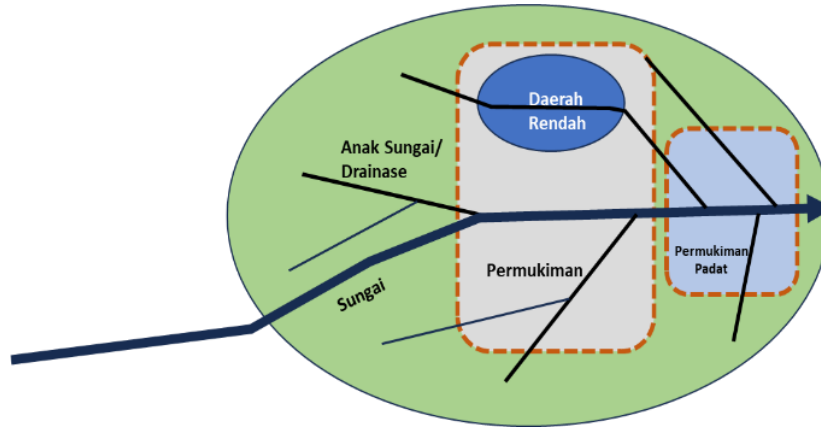


Figure 1. Watershed

With the emergence of Nature-Based Solutions (NBS) as a cost-effective alternative to conventional grey infrastructure, they provide better long-term resilience and offer a number of additional benefits (Damon, 2024). This grey infrastructure refers to buildings and mechanical equipment, such as reservoirs, dikes, pipes, pumps, water treatment installations, and canals. These engineered solutions are integrated into river areas or coastal ecosystems, where hydrological and environmental characteristics greatly influence the performance of the infrastructure (Adams et al., 2024).

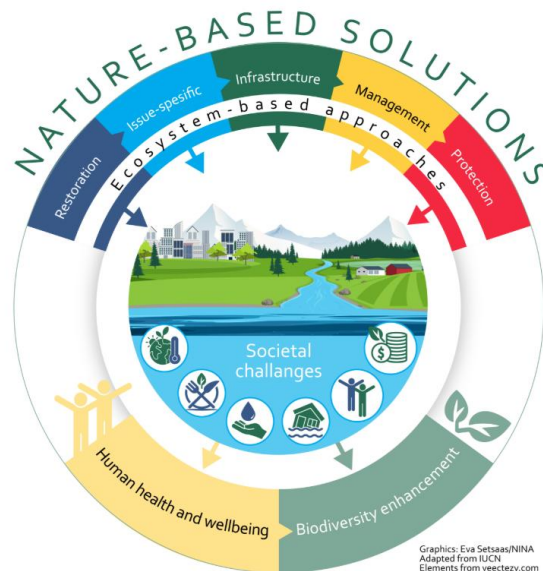


Figure 2. Social Challenges (Sowińska-Świerkosz & García, 2021)

2. 2. NBS Mechanism for Water Quality Improvement

Common NBS elements used for water quality mitigation include riparian buffers, constructed wetlands (including floating treatment wetlands), bio-swales, rain gardens, and natural riparian vegetation (Herrmann-Pillath et al., 2023). The main mechanisms relied upon are:

- Absorption and transformation of nutrients (microbial denitrification, plant assimilation).

- Sedimentation and physical filtration for suspended particles (TSS).
- Reduction of dissolved organic matter through biological degradation (reducing BOD/COD).
- Increased infiltration, thereby reducing surface runoff that carries pollutants.

systematic studies show that a combination of NBS elements can significantly reduce nutrient and sediment loads if design, size, and maintenance are appropriate (Sowińska-Świerkosz & García, 2021).

2. 3. Evidence of the effectiveness of empirical findings summary

Several reviews and empirical studies in the last decade report the effectiveness of NBS for water quality improvement at various scales:

- a. Riparian buffers & vegetated strips modeling studies and observations show that adequate buffer width correlates with reduction in nutrients and sediments; the response is sensitive to local hydrological and climatic conditions.
- b. Constructed wetlands & floating treatment wetlands reports and case studies show reductions in BOD, TSS, N-nutrients, and coliforms under various conditions if design layout, hydraulic retention time, and vegetation are properly selected.
- c. General review of NBS for urban water comprehensive reviews (2020–2024) report that NBS provides significant co-benefits (biodiversity, social) but water quality outcomes highly depend on a combination of technical measures and stakeholder involvement. Main barriers are land ownership, long-term funding, and operation/maintenance capacity.

3. 1. Time and Research Location

Throughout the main course of the Cisadane River (upstream, middle, upstream downstream) including representative points (upstream/vegetated area, agricultural/peri-urban area, industrial/urban area, estuary/downstream). Segment selection follows the regional division map and monitoring points of BBWS Ciliwung Cisadane (PSDA pattern map and monitoring points). Sample point plan (example total 2 locations; can be adjusted):

1. Upstream (headwater) near the source/upstream boundary (capturing natural conditions).
2. Upper catchment (vegetated upstream area/subsystem) assessing contributions from land conversion.
3. Tributary confluence (tributary carrying waste) location where large tributary flows in.
4. Upper-midstream (agricultural/peri-urban area) influence of agriculture and settlements.
5. Midstream (near small industrial/market area) close to domestic industrial discharge points.

3. 2. Research Methodology

The research was conducted over a period of 1 year, with implementation for 11 months each year. The research stage is TKT 3, which is the proof of concept of the nature-based solution application to the clean water crisis in the Cisadane River. Research location: Cisadane River, which is experiencing water quality degradation. The laboratories used are the geotechnical laboratory of Civil Engineering and the water quality laboratory at the Environmental Engineering Department of Trisakti University.

Research Method: mixed methods with a multidisciplinary approach. Quantitative methods are used to measure technical and environmental performance (water quality level, function degradation, land cover changes) through field and laboratory measurements. Qualitative methods are used to interpret quantitative results as well as perceptions through observation, interviews, and document studies.

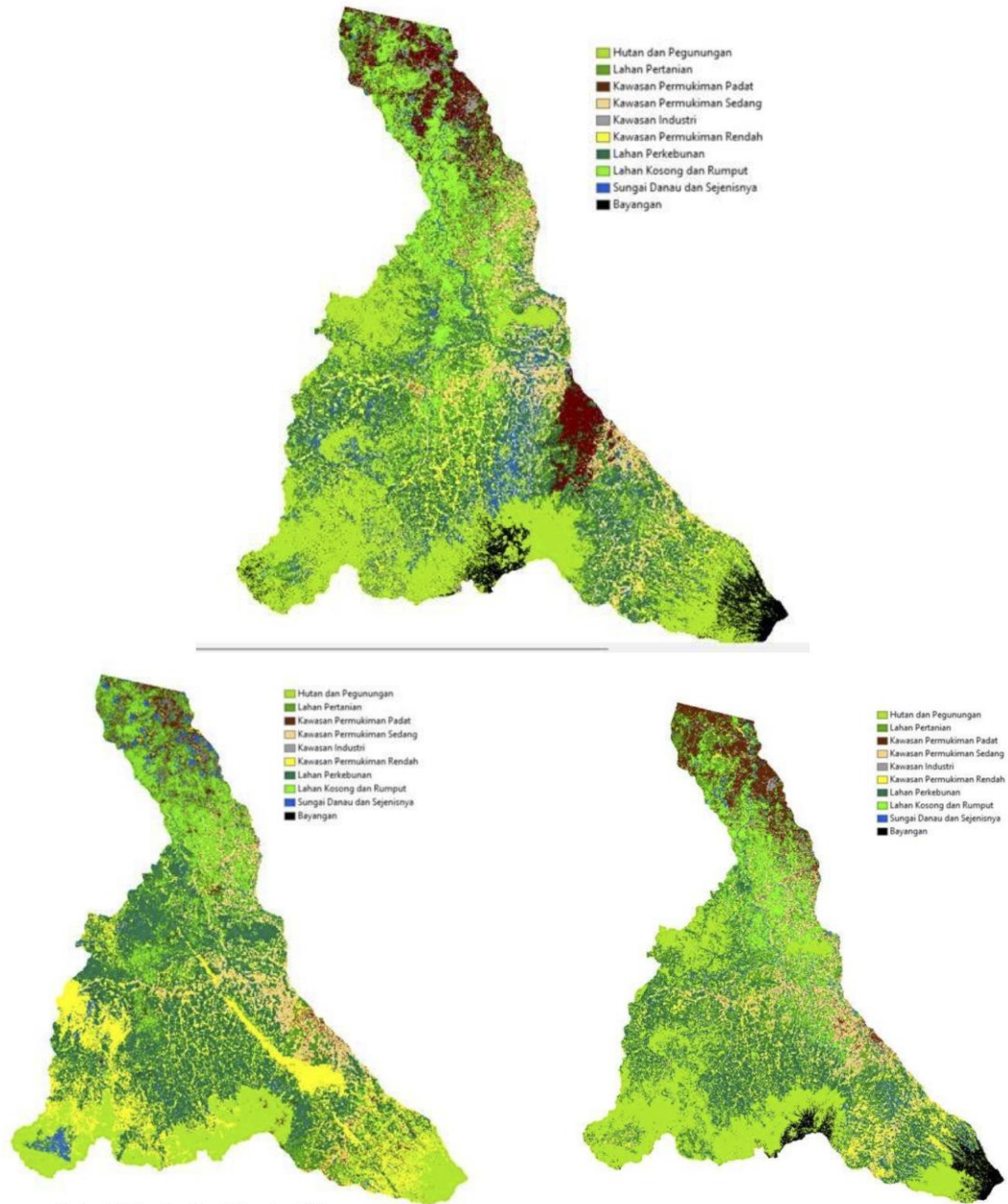


Figure 3. (a) Land Use in 2013

(b) Land Use in 2019

(c) Land Use in 2022 (Maulana & Hidayat, 2024)

3. 3. Methodology Analysis

The focus of the first year (2026) is nature-based solutions for mitigating the clean water crisis in the Cisadane River. The data and analyses conducted are:

1. Field measurements: river water quality, changes in land cover. Field observations are conducted in the upstream area of the Cisadane River.
2. Interviews: with water discharge monitors or communities concerned with the Cisadane River.
3. Laboratory analysis: soil types and water quality.
4. Descriptive analysis: key themes from interviews, geological characteristics of soil and water quality, and land cover.

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CHAPTER 3

Analysis of XCD and Starch Additives on the Rheological Properties of Brine Completion Fluids

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ABSTRACT

Problem statement: The use of high specific gravity ($SG = 1.7$) nitrate salt-based completion fluids often suffers from rheological instability when formulated without appropriate additives, potentially triggering solids suspension failure and formation damage. Consequently, the fluid was diluted with fresh water to achieve SG variations of 1.3, 1.4, and 1.5 to evaluate the impact of density modifications on the rheological characteristics and stability of completion fluids.

Purpose of the study: This study aims to analyze and compare the effects of adding XCD polymer and starch (at mass variations of 1, 2, 3, 4, and 5 grams) on the rheological properties of nitrate salt completion fluids across various density levels.

The method: Laboratory experiments were conducted by preparing base nitrate salt fluids at densities of 1.3, 1.4, and 1.5 SG. For each density, XCD polymer (1–5 grams) and starch (1–5 grams) were added separately for comparative evaluation. Rheological testing included measurements of plastic viscosity (PV), yield point (YP), and gel strength using a standard API Fann VG Meter.

Result: The experimental results indicated that the addition of XCD polymer provided a significantly more pronounced and stable increase in viscosity and yield point compared to starch across all three density variations. At a higher density (1.4), the high concentration of nitrate salt slightly hindered additive hydration; however, XCD at concentrations of 4 and 5 grams maintained better rheological stability than starch.

Conclusion: In conclusion, XCD polymer demonstrates superior performance as a viscosifier compared to starch in nitrate salt completion fluid systems, where its effectiveness is heavily influenced by the density level of the base fluid.

Key Words: XCD, Starch, Rheology, Specific Gravity, viscosifier.

1. INTRODUCTION

In upstream oil and gas operations, drilling fluids and completion fluids are two critical components that determine the success of well construction. While drilling fluids primarily function to transport drill cuttings and maintain wellbore stability during the rock penetration phase, completion fluids take over this vital role once the target depth is reached. Completion fluids are specifically engineered to facilitate the well completion phase, which encompasses casing installation, perforation, and well clean-up operations. Unlike conventional drilling fluids that are rich in suspended solids (such as bentonite or barite), completion fluids should ideally be solids free brines to prevent rock pore plugging and subsequent formation damage. To achieve high density without the addition of solid weighting agents, dissolved salts such as nitrate salts are frequently utilized as the base for high-density completion fluids with a specific gravity (SG) of up to 1.7.

1.1 MATERIAL

Transforming the fundamental function of a purely solids-free completion brine into a fluid with hydrodynamic capabilities akin to drilling fluids particularly for particle transport and cuttings suspension demands a robust intervention in its rheological architecture. In the absence of a colloidal solid fraction such as bentonite, the generation of thixotropic properties, Yield Point (YP), and Plastic Viscosity (PV) relies entirely upon water-soluble polymer viscosifiers. Within this framework, XCD polymer (Xanthan Gum) and modified starch are selected due to their distinct functional behaviors when interacting with the highly concentrated electrolyte environment of nitrate salts.

a. Polymer XCD (*Xanthan Gum*)

XCD polymer is a high molecular weight exopolysaccharide produced through the fermentation of the bacterium *Xanthomonas campestris*. Under static conditions or low shear rates, the XCD polymer chains entangle to form a dense three-dimensional structural network via hydrogen bonding, yielding high structural viscosity that effectively maintains solids suspension. Conversely, when subjected to high shear rates such as when passing through drill bit nozzles the polymer chains align parallel to the flow direction, drastically reducing viscosity to minimize circulation pressure losses. In high density nitrate salt brine systems (SG 1.5), the rigid double helix conformation of XCD acts as an internal shield. This conformation provides superior mechanical and thermal resistance against the chain coiling effects induced by the electrostatic attraction of nitrate ions, thereby preserving inter chain hydrophobic interactions to maintain a stable Yield Point.

b. Aditif Starch

In contrast to XCD, starch or modified starch is a branched polymer composed of glucose units (amylose and amylopectin). Within the drilling fluid industry, starch is primarily integrated as a fluid loss control agent through the formation of a colloidal-phase thin matrix (filter cake) along the wellbore wall. Nevertheless, it also provides a secondary contribution as a viscosifier to enhance fluid viscosity. The primary thermodynamic challenge in formulating these two additives lies in the variations of specific gravity (SG) within the nitrate salt base. As the nitrate salt concentration is elevated to achieve the target density of SG 1.5.

1.2 RHEOLOGY PARAMETER

This section provides a comprehensive review of the crucial parameters governing the hydrodynamic and functional characteristics of drilling fluids, focusing primarily on four key rheological and filtration properties. These parameters encompass plastic viscosity (PV), representing flow resistance driven by mechanical friction between particles; yield point (YP), serving as an indicator of the minimum electrostatic force required to initiate fluid flow; gel strength, which measures the

thixotropic capacity of the system to suspend drill cuttings under static conditions; and filtration loss, which governs the volumetric migration of the liquid phase into the rock matrix. The integration and balance of these four parameters form the primary foundation for ensuring efficient hole cleaning, maintaining the mechanical stability of the wellbore, and minimizing the risk of formation damage.

a. Plastic Viscosity

Plastic Viscosity (PV) is a rheological parameter that represents the internal resistance of a fluid to flow, which is physically governed by the concentration, size, and shape of suspended solid particles, alongside the intrinsic viscosity of its base fluid phase. In drilling and completion fluid management, excessively high PV values are highly undesirable; the elevated internal mechanical friction demands greater pumping pressures, thereby risking spikes in Equivalent Circulating Density (ECD) and reducing the Rate of Penetration (ROP). Consequently, an hydraulically ideal fluid formulation requires a low PV value combined with a high Yield Point (YP). This configuration yields an elevated YP/PV ratio, which is proven optimal for enhancing cuttings transport efficiency to the surface while simultaneously conserving circulation energy.

b. Gel strength

Gel strength is defined as an indicator of a drilling fluid's capacity to support and suspend drill cuttings, preventing them from settling within the wellbore when circulation is temporarily halted (static conditions). In accordance with American Petroleum Institute (API) standard procedures, this rheological property is measured using a viscometer after the fluid has remained undisturbed under static conditions for specific time intervals, namely 10 seconds and 10 minutes. The resulting readings of this parameter are expressed in units of lbs/100 ft².

c. Yield point

Yield Point (YP) is a rheological parameter that represents the minimum yield stress threshold required to initiate fluid movement or flow. This initial resistance is governed by the electrostatic interactions between electrical charges on the surfaces of suspended particles, causing the fluid to manifest mechanical properties akin to an elastic solid (strain recovery) if the applied circulation stress fails to surpass this YP threshold. In drilling and completion hydraulics management, the YP value must be precisely regulated; although a high YP is crucial to optimize cuttings transport capacity, an excessively elevated value will conversely exacerbate frictional pressure losses within the annulus, leading to a surge in Equivalent Circulating Density (ECD) that risks inducing formation fracturing.

d. Filtration loss

Filtration loss is a functional parameter that represents the volume of the liquid phase (filtrate) filtering out of the fluid system and invading the permeable reservoir rock matrix due to an overbalanced hydrostatic pressure differential. Within wellbore fluid dynamics, filtration rates that are not rigidly controlled will lead to the formation of a thick, permeable filter cake, which mechanically escalates the risk of differential sticking and wellbore narrowing. Furthermore, excessive filtrate invasion into the target zone is highly susceptible to degrading reservoir productivity through formation damage mechanisms, specifically driven by the hydration of clay minerals (clay swelling). Consequently, the integration of fluid loss control agents, such as starch or non-ionic polymers, becomes absolutely imperative to restrict the invasive excursion of the fluid.

2. METHODOLOGY

This laboratory experimental procedure is structured into two primary testing phases: the evaluation of rheological properties using a Fann VG Meter (rotational viscometer) and the assessment of filtration characteristics using a standard API Filter Press under Low-Pressure, Low-Temperature (LPLT) conditions.

2.1 Rheological Testing (PV, YP, and Gel Strength)

The testing of rheological parameters, which encompasses Plastic Viscosity (PV), Yield Point (YP), and Gel Strength, is conducted to characterize the mechanical behavior and flow deformation properties of the fluid under the influence of shear stress. Utilizing hydraulic simulation via a standard Fann VG Meter (rotational viscometer) in accordance with API RP 13B-1 regulations, this procedure aims to quantitatively map the frictional and electrostatic interactions within the fluid matrix. The evaluation of these parameters is highly crucial for predicting pumping power efficiency, cuttings transport capacity, and the suspension stability of the colloidal phase when circulation is halted, thereby ensuring operational integrity and minimizing the risk of technical complications within the wellbore.

1. The equipment and materials

The equipment and materials utilized in this testing phase consist of a Fann VG Meter (either a standard 6-speed or 2-speed model), a thermostatic sample cup, and the nitrate salt completion fluid sample (SG 1.5) which has been homogeneously mixed with the designated additives (XCD and starch).



Figure 2.1 Fann VG Meter

2. Work Procedures

- a. The completion fluid sample is poured into the viscometer cup until it reaches the predetermined scribed line.
- b. Equipment Positioning: The sample cup is placed onto the Fann VG Meter stage, which is then raised until the rotor sleeve is submerged precisely up to the scribed immersion line on the sleeve.
- c. Temperature Conditioning: The fluid temperature is measured and verified to be constant (either at ambient room temperature or a specific test temperature, e.g., 120°F) utilizing a thermometer.
- d. 600 RPM Dial Reading: The rotational speed of the instrument is set to 600 RPM, and the indicator dial is allowed to stabilize.
- e. 300 RPM Dial Reading: The rotational speed of the instrument is adjusted to 300 RPM, and the indicator dial is allowed to stabilize.

f. 10-Second Gel Strength Measurement (Initial Gel):

- The fluid is re-agitated at 600 RPM for 15 seconds to disrupt any residual gel structure.
- The instrument is turned off, and the fluid is allowed to remain completely undisturbed for exactly 10 seconds. The gear is then shifted to the low-speed setting (3 RPM), the motor is turned on, and the maximum dial deflection (peak reading) before the dial recedes is recorded.

g. 10-Minute Gel Strength Measurement:

- The fluid is re-agitated at 600 RPM for 15 seconds.
- The instrument is turned off, and the fluid is allowed to remain undisturbed under static conditions for exactly 10 minutes. The motor is then turned on at 3 RPM, and the maximum dial deflection is recorded.

3. Calculation Formula

The Plastic Viscosity and Yield Point values are mathematically derived through the conversion of dial readings utilizing the following standard API equations:

1. Plastic Viscosity (PV):

$$PV = \theta_{600} - \theta_{300} \text{ (PV is the plastic viscosity in centipoise (cP))}$$

2. Yield Point (YP):

$$YP = \theta_{300} - PV \text{ (Yield Point (YP) in lb/100 ft}^2\text{)}$$

3. Gel Strength:

The values are obtained directly from the peak dial reading at 3 RPM following the static phase (expressed in units of lb/100 ft²).

2.2 Filtration Loss Parameter Testing

Filtration loss testing is conducted to evaluate the mechanistic capability of the fluid to restrict filtrate migration into the permeable reservoir rock matrix. By simulating overbalanced hydrostatic pressure conditions using a standard API Low-Pressure, Low-Temperature (LPLT) Filter Press, this procedure aims to quantitatively measure the accumulated filtrate volume while simultaneously analyzing the physical characteristics of the filter cake deposited on the filter paper surface over a standard 30-minute interval. A comprehensive understanding of this filtration behavior is highly crucial to minimize the risk of formation damage induced by foreign fluid invasion during both drilling and completion operations.

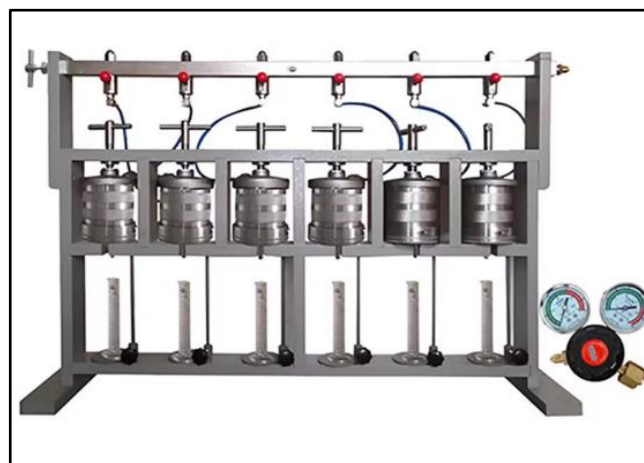


Figure 2.2 LPLT Filter Press

1. The equipment and materials

- API Standard LPLT Filter Press.
- API Standard Filter Paper (Whatman No. 50 or equivalent).
- 10 mL or 25 mL Graduated Cylinder.
- Gas Pressure Source (CO₂ Cartridge).
- *Stopwatch*.

2. Work Procedures

- **Membrane Installation:** Ensure the filter cell tube components are clean and dry. Install the rubber gasket, support screen, and one sheet of API filter paper at the base of the tube, then lock it tightly.
- **Sample Filling:** Pour the completion fluid sample into the filter cell tube until leaving a free space of about 0.25 inches (about 6 mm) from the top of the tube for pressure expansion space.
- **System Assembly:** Install the top cover of the tube, place the filter cell on the support frame, and position the measuring cylinder directly under the outlet pipe to collect the filtrate liquid.
- **Pressurization:** Connect the gas pressure hose to the filter cell. Apply a constant regulator pressure of 100 psi for less than 30 seconds.
- **Timing:** Start the stopwatch when the pressure reaches 100 psi.
- **Filtrate Collection:** Allow the filtration process to take place for exactly 30 minutes.
- **Recording Results:** After 30 minutes, close the gas pressure valve, safely release the remaining pressure in the tube, and record the total volume of filtrate liquid collected in the measuring cylinder in milliliters (mL).
- **Filter Cake Inspection (Optional but recommended):** Carefully open the filter cell tube, remove the filter paper, then wash the remaining fluid using a slow stream of distilled water. Measure the thickness of the solid/polymer layer (filter cake) formed using a vernier caliper (expressed in mm or per 1/32 inch).

3. RESULTS AND DISCUSSION

This chapter delineates the results of the rheological evaluations, encompassing the characterization of the initial nitrate base brine up to the modifications induced by XCD and starch.

3.1 Rheological Characteristics of Nitrate Salt Base Brine and the Impact of Dilution

Based on laboratory testing, the initial characteristics of the baseline completion fluid utilizing a pure saturated nitrate salt system prior to formulation with polymer additives are presented in Table 3.1 and Table 3.2.

Tabel 3.1 Rheologi Brine with nitrat salt

Parameter	Initial Value
<i>Specific Gravity (SG)</i>	1,686 (1,7)
<i>Plastic Viscosity (PV)</i>	56 cp
<i>Yield Point (YP)</i>	5 lb/100ft ²
<i>Gel Strength 10 detik</i>	1 lb/100ft ²
<i>Gel Strength 10 menit</i>	1 lb/100ft ²
pH	5,01
Filtration Loss	-

The utilization of nitrate salt as a base brine is specifically selected for its capability to achieve high fluid density through its remarkably high solubility within the aqueous phase. In its baseline state (Table 3.1), this base brine can reach a Specific Gravity (SG) of 1.686 (~1.7) without employing solid weighting agents, rendering it completely solids-free (unlike conventional systems using barite). This solids-free characteristic of the nitrate salt is highly critical during the completion phase to eliminate the risk of mechanical plugging within the pores of productive formations or sand screens.

- Despite being entirely free of solids, this baseline fluid exhibits a significantly high initial Plastic Viscosity (PV) of 56 cP. This physical phenomenon can be elucidated through the following mechanisms:
- **Molecular-Level Hydraulic Friction:** The elevated PV in this pure brine is solely governed by hydraulic mechanical friction at the molecular level, stemming from the high density of dissolved nitrate ions and their counterpart cations within a confined volume of water.
- **Newtonian Fluid Behavior:** On the other hand, the remarkably low Yield Point (YP) of 5 lb/100ft² and the baseline 10-second and 10-minute gel strengths of 1 lb/100ft² confirm that this pure nitrate base brine exhibits perfect Newtonian fluid behavior. The fluid possesses no internal electrostatic structural network to suspend foreign solid particles once circulation is stopped.
- **pH Characteristics:** The initial pH value of 5.01 indicates a weakly acidic nature, which is characteristic of certain saturated nitrate salt solutions resulting from partial hydrolysis in water.

Tabel 3 . 2 Rheologi CF SG 1,5

Parameter	CF (SG 1,5)
<i>Specific Gravity (SG)</i>	1,5
<i>Plastic Viscosity (PV)</i>	8 cp
<i>Yield Point (YP)</i>	1 lb/100ft
<i>Gel Strength 10 detik</i>	1 lb/100ft ²
<i>Gel Strength 10 menit</i>	1 lb/100ft ²
pH	5.57
Filtration Loss	-

Upon performing pure dilution with distilled water to reduce the fluid density to SG 1.5 (Table 3.2), a profound reduction in rheological parameters is observed. At SG 1.5, the PV decreases sharply to 8 cP, while the YP drops to 1 lb/100ft². This decline in PV is directly proportional to the reduction in the ionic

density of the liquid phase per unit volume of fluid, induced by the introduction of free water molecules, which subsequently diminishes inter-ionic frictional forces. Furthermore, this pure dilution yields a constant gel strength at the absolute minimum value of 1 lb/100ft², demonstrating a complete absence of thixotropic behavior. These baseline characteristics firmly validate the critical necessity of rheological engineering through the incorporation of a viscosifying additive.

3.2 Analysis of the Effect of XCD Polymer on the Rheology of SG 1.5 Drilling Fluid

The incorporation of XCD (xanthan gum) polymer with mass variations ranging from 1 gram to 5 grams into the SG 1.5-based completion fluid induces a profound structural thickening effect, as summarized in Table 3.3.

Tabel 3 . 3 Rheologi CF SG 1,5 + XCD 1-5 gr

Parameter	CF (SG 1,5)				
XCD (gr)	1	2	3	4	5
Specific Gravity (SG)					
<i>Specific Gravity</i>	1,5	1,165	1,155	0,840	0,731
Plastic Viscosity (PV)					
<i>Plastic Viscosity</i>	11	13	27	65	92
Yield Point (YP)					
<i>Yield Point</i>	2	42	76	90	101
Gel Strength 10 detik					
<i>Gel Strength</i>	1	3	16	35	53
Gel Strength 10 menit					
<i>Gel Strength</i>	2	4	20	44	64
pH	5,36	5,39	5,33	5,24	5,19
Filtration Loss	-	-	-	-	-

As the XCD concentration increases from 1 gram to 5 grams, the PV value escalates progressively from 11 cP to 92 cP. Simultaneously, a highly pronounced surge in YP is observed, jumping sharply from 2 lb/100ft² (at 1 gram of XCD) to 101 lb/100ft² (at 5 grams of XCD). This elevation in YP demonstrates the efficacy of the XCD biopolymer chains in establishing a cohesive three-dimensional structural network within the liquid phase via hydrogen bonding, thereby transitioning the fluid flow behavior away from a Newtonian regime. Furthermore, robust thixotropic properties are firmly developed, as evidenced by the substantial increase in both the 10-second gel strength (from 1 to 53 lb/100ft²) and the 10-minute gel strength (from 2 to 64 lb/100ft²). However, a highly anomalous phenomenon occurs regarding the fluid density (Specific Gravity), wherein the SG values exhibit a consistent and drastic decline from 1.5 down to 1.165 and 1.155, eventually reaching a minimum threshold well below the density of water specifically 0.840 and 0.731 upon the addition of 4 and 5 grams of XCD, respectively.

3.3 Analysis of the Effect of Starch Additives on the Rheology of SG 1.5 Drilling Fluids

The variation patterns of physical and rheological parameters induced by the incorporation of starch additives, with mass concentrations ranging from 1 gram to 5 grams into the SG 1.5 baseline completion fluid, are summarized in Table 3.4. The experimental results demonstrate a highly contrasting trend when compared to the performance characteristics of the XCD polymer.

Tabel 3 . 4 Rheologi CF SG 1,5 + Starch 1-5 gr

Parameter	CF (SG 1,5)				
Starch (gr)	1	2	3	4	5
Specific Gravity (SG)					
<i>Plastic</i>	1,503	1,510	1,512	1,512	1,510
<i>Viscosity (PV)</i>					
<i>Yield Point (YP)</i>	9	10	12	15	16
<i>Gel Strength 10 detik</i>	1	2	2	2	2
<i>Gel Strength 10 menit</i>	2	1	2	3	2
pH	3	2	2	4	2
Filtration Loss	5,44	5,38	5,24	5,58	5,39
	-	-	-	-	-

The primary characteristic observed within this starch-modified system is the remarkably high stability of the fluid density. Specifically, the Specific Gravity (SG) remains exceptionally stable within a narrow range of 1.503 to 1.512, with the incremental addition of starch up to 5 grams inducing no reduction in SG whatsoever. This behavior mechanistically demonstrates that the starch additive does not promote air entrainment. The absence of entrapped air is attributed to the fact that starch fails to build extreme structural viscosity at low shear rates or develop a gel strength robust enough to lock in air bubbles generated during high-speed agitation.

Regarding Plastic Viscosity (PV), the parameter exhibits only a moderate and linear increase, escalating from a baseline of 8 cP to 9 cP with 1 gram of starch, and reaching a maximum of 16 cP at 5 grams. This minimal PV elevation reflects standard mechanical friction arising from the increased concentration of dissolved polymer solids, in the absence of excessive polymer chain elongation. Furthermore, the Yield Point (YP) displays a nearly flat trend, remaining strictly between 1 and 2 lb/100ft² across all concentration variations. Aligned with the YP behavior, the 10-second gel strength (1–3 lb/100ft²) and 10-minute gel strength (2–4 lb/100ft²) are also constrained to near-minimum limits. These data firmly confirm that starch does not contribute to the development of flow-restricting electrostatic networks or thixotropic fluid properties.

CONCLUSION

Based on the laboratory testing results and comparative analyses conducted regarding the rheological characteristics of the nitrate salt base brine, alongside the effects induced by the incorporation of XCD and starch polymer additives, the following primary conclusions can be derived:

- **Pure Base Brine Characteristics:** The baseline completion fluid formulated from a saturated nitrate salt system optimally achieves a high density (SG 1.686) under completely solids-free conditions. This fluid exhibits perfect Newtonian behavior, characterized by near-minimum Yield Point (YP) and gel strength values (1–5 lb/100ft²), yet displays a high initial Plastic Viscosity (PV) of 56 cP driven by the predominance of molecular-level hydraulic friction among the dissolved ions. These rheological parameters decrease linearly with increasing volumes of pure dilution.
- **Influence of XCD Polymer:** The incorporation of XCD (xanthan gum) polymer into the SG 1.5 baseline fluid successfully transitions the system into a highly pseudoplastic (shear-thinning) state, as evidenced by a pronounced surge in YP up to 101 lb/100ft² and a 10-minute gel strength of up to 64 lb/100ft² at a 5-gram concentration. This behavior demonstrates the high efficacy of XCD in establishing a robust three-dimensional structural network required for optimal cuttings transport.
- **Physical Stability of Starch Additive:** In stark contrast to XCD, the starch additive (modified starch) functions via pure dispersion without establishing an interconnected gel network within the liquid phase. The incremental addition of starch up to 5 grams preserves the density stability of the fluid column exceptionally well within a narrow range of SG 1.503 to 1.512 (remaining entirely free from air entrainment effects), while inducing a highly moderate increase in PV (reaching a maximum of 16 cP) and maintaining YP and gel strength values at near-minimum thresholds.
- **Optimum Reservoir Drill-In Fluid (RDIF) Formulation:** Based on functional correlations, the single-agent application of either XCD alone or starch alone within the nitrate salt base brine is not recommended for drilling operations within the reservoir zone. Instead, the optimal formulation required to convert the completion fluid into a drilling fluid that is safe for productive formations is a combined system consisting of XCD, starch, and a defoamer. This synergistic blend serves to maximize cuttings transport capacity, safeguard pore walls via a temporary filter cake, and maintain wellbore hydraulic density stability.

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CHAPTER 4

SPICY SPLENDID SENSATION: The Rise of Korean Delicacies in Indonesia with The Absence of Advertisement

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ABSTRACT

The global spread of Korean popular culture, often called the Korean Wave or Hallyu, has really shaped consumer behavior in Indonesia. This paper looks at how cultural proximity, especially that shared comfort rice-centered meals, and those matching side dishes, made Korean delicacies easier to accept across the country, even without leaning too hard on old style traditional advertising.

Using a historical lens on Indonesia's long-standing spice culture, and also its real love for spicy food, the study then connects the dots with how Indonesian and Korean cuisines feel similar in day-to-day practice. From there it explains why Korean instant noodles, and other spicy items, got strong market traction. In short, the results seem to come from perfect timing as Hallyu rose, plus the presence of long-established Korean communities in Indonesia, and then the very natural fit between local taste habits and what Korean brands were offering.

Even though there is almost no mass media push, unlike local competitors, Korean spicy noodles still keep steady demand. That steadiness is linked to cultural resonance, competitive pricing, some bundling strategies, and the simple fact that the products feel familiar. So this case suggests that having deep cultural insight, combined with smart market timing, can beat conventional promotion efforts, when the goal is faster consumer adoption and business growth.

Overall, the findings can help marketers and startups a lot, particularly if they want to use cultural similarities and wider globalization currents to enter emerging markets in a more effective way

Keywords: Korean pop culture, culture, globalization, spicy food, Indonesia, appetite.

I. INTRODUCTION

Humans as social creatures live in groups. Starting from the simplest form of group consisting of two people and mostly related by marriage, a couple forms a family which also is the closest unit of society almost every individual knows. Families will then form larger groups such as society, clan, tribe, nation, country or race, which each has its own culture. Culture is defined as the way of life, especially the general customs and beliefs of a particular people at a particular time (Cambridge University Press, 2017). It describes also characteristics and knowledge of a particular group of people that exist in many things including language, religion, social habits, arts, music and even cuisine. Etymologically, the word *culture* itself derives from French word that is also derives from Latin *colere*, means to grow, to cultivate and also nurture. Thus, culture is closely associated with growth and development since cultural diversity grows along as groups of people grow (Zimmermann, 2015).

Nowadays in the globalization era when boundaries between countries and nations are minimized by technology, culture plays a big role as a differentiator. Every country and nation has its uniqueness that present in the culture. Many major types of culture exist such as western, eastern, Latin, middle-eastern as well as African that each also has many smaller subculture. Further with the continuing development of human civilization, culture is constantly changing in some way because the people are also changing. When modern era is discussed, even though culture is differentiating countries and nations, it cannot be denied that it is interrelated because one culture might also affect the other culture (Zimmermann, 2015).

In business, culture exists as well. Companies set their culture in their beginning cycle to make sure that their employees work in the defined environment and align their culture together with company value, mission, ethics and also goals. Discussing about business, marketing department as the tip of the spear has a lot works to do. Marketing itself defines the activity, set of institutions, and process for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large (American Marketing Association, 2013). Responsible as the marketing professor for more than 40 years in Northwestern University's Kellogg School of Management, Philip Kotler is respected as the father of modern marketing. One of his most major contributions in the world of marketing is to popularize the Marketing Mix known as well as the Four Ps of Marketing, which is firstly suggested and developed by academic Jerome McCarthy in 1960 (Mahajan, 2013). According to Kotler, Marketing is the science and art of exploring, creating and delivering value to satisfy the needs a target market at a profit that identifies unfulfilled needs and desires. It defines, measures and quantifies the size of the identified market and the profit potential. It pinpoints which segments the company is capable of serving best and it designs and promotes the appropriate products and services (Cohen, 2011).

Culture's influence affects the process of planning and running a business. A character that distinguishes a community is a substance to derive profit. Marketing should have mastered the acquaintance of the mood that surrounds a place before it proceeds to starting a business. Companies these days have been adapting to a new trend LGBT (Lesbian, Gay, Bisexual and Transgender) to branch out. Human Rights Campaign is a way to encourage gay partners to open up.

Despite supporting LGBT rights, brands use this campaign to win customers and consumers through commercials, enlightening their spirit in the world of politics and bullying. According to Google Customer Survey 2014, over 45% of consumers under 34 years old tend to repeat business with an LGBT-friendly

company. More than 54% would choose a brand that focuses on equality – equal rights for LGBT community. On 2014, Burger King broadcasted a bold statement in support of LGBT. “Be Your Way” project where a limited edition “Proud Whopper” burger was added to the menu was created to blend in San Francisco Gay Parade. Proud Whopper was a classic *whopper* but wrapped in the colors of LGBT symbol wrapper with a signature “We are all the same inside.” Menu was available exclusively at the Burger King restaurant at 1200 Market Street in San Francisco about July 3. Proud Whopper ad reached 20% of the US population, and young millennials. Media channels, including The Wall Street Journal and Bloomberg, honored the campaign.

II. THEORITICAL REVIEW

II.1. INDONESIAN HISTORY WITH SPICES

Indonesia, the biggest archipelago in the world, has been and still is affiliated with spices. Dating back to centuries ago, spices available in Indonesia is one of the reasons explorers from the West came to the country. Combination of humid air and moist soil, plants in Indonesia resulted extremely well and captivates the Western’s interest. Vasco da Gama, a Holland origin who discovered that Indonesia is a spice heaven as early as the 1400s, conducted first well-known exploration. The Westerners furthermore sought after spices after it emerged as a renowned ingredient amongst Portuguese, which was nutmeg (Eunice, 2012).

Due to the high demand and increasing opportunity of trade, Vasco da Gamma helped initiated Kompeni VOC - A Dutch conglomerate specifically operating upon the trade of spices in Indonesia. From this institution, Kompeni VOC was able to monopoly the overall supply (Rachman, 2014). Competitions were tough as there were only two players targeting spices in Indonesia, which was the English. Conflict of land kept ongoing simply due to the prosecuting of spices. Spices were highly valued to an extent that island which does not comply in spice trading will be disrupted by Kompeni VOC to further control the supply of spices in Indonesia (Rachman, 2014).

Figure 1: Sources of Spices



Source: (Fidertendiardi, 2016)

One of the biggest evidence of spice monopoly in Indonesia can be seen from the historical site located in Kalimantan, precisely in the island of Banda Neira. European colonies symbolize their domination of the island by building the Belgica Fort. Ironically, significant amount of money made from spice trading were eventually used to fund the colonization Indonesia in the later century (Fidertendiardi, 2016).

II.2. INDONESIAN LOVE OF SPICY FOOD

Being part of the traditional plants, spices have become important ingredients in many Indonesian delicacies. Even until present day, usage of Indonesian spices makes Indonesian spices one of the most important commodities driving the economy of the nation. Numerous variations of food are available from the East to West part of Indonesia, as there are many cultures and traditions. Spice is an ingredient that remains in almost every traditional Indonesian meal. Seen from Rendang, satay even some deserts from Manado have been known to include spices as part of the ingredients (Fadil, 2017).

Children were born being familiar with spices as part of the daily consumption. Households in Indonesia have supplies of various spices as part of their kitchen ingredients. These has been circulating for decades, that spices have become a mutual interest amongst Indonesian regardless of the cultural background. According to CNN, Indonesia is ranked top three of countries with the spiciest food along with China and India (Schonhardt, 2016).

The love of spicy food is further reflected from the variation of snacks available in stores. Numerous brands offer spicy flavors of snack. Although some delicacies are not spicy (traditional Grilled Fish or Fried Chicken), the meal is served with complimentary *sambal*. Sambal is not precisely a meal; instead it is a sauce complimentary to complete the meal with spicy flavoring. Varieties of sambal are offered depending on the origin of the food. Though, the base of sambal remains the same; Chilli. Sambal is not invented during the recent days; it has originated decades ago by the initiation of traditional cooking. This furthermore dictates how Indonesian cuisine is inevitable to be separated from spiciness (Moncel, 2016).

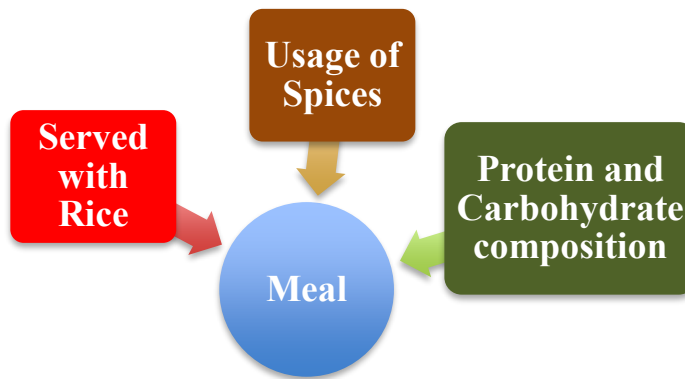
II.3. KOREAN IN INDONESIA

Asian delicacies in general are no stranger to the use of spice. Including Korean. Korean foods are common in Indonesia. Usages of basic ingredients are unexceptional to Indonesian preferences; even so the usage of rice as part of main dish is similar to Indonesian. During the 1970s, notable amount of Korean immigrant reside in Indonesia. Hence, some part of the city is occupied by Korean residence. Eventually, Korean restaurant was introduced and quickly accepted by locals. In Jakarta particularly, Korea Town was established in the region of Kebayoran Baru, Southern Jakarta, where even until present time, is easy to spot Korean restaurants and supermarket (Sang-Jae, 2006).

II.4. SIMILARITIES BETWEEN INDONESIAN AND KOREAN DELICACIES

Significant types of meal, both Korean and Indonesian, are served with rice and are served in a resembling manner. Breakfasts in Korea commonly uses rice as part of the dish, where in Indonesia usage of rice for breakfast can be seen in different forms; either it being fried or porridge. Korean delicacies in Indonesia are easily found. The preferences of local people are alike (Wardoyo, 2017). Particularly for taste, spicy is unexceptional amongst Korean and Indonesian food. Sambal is as demanded as the main course itself in Indonesia, even restaurants occasionally has a separated sections of menu to show varieties of sambal. Other than sambal, Indonesians are also accustomed to spicy seasoning, which resembles the traditional Korean *Gochugaru* (Wardoyo, 2017). Another resemblance of meal between the two cultures is the composition. Rice has become the center of the main dish, and usually complimented with a variety of protein and vegetables. The traditional Korean dish is served along with numerous assortments, much like how Indonesian have complimentary dishes to furthermore galvanize the meal (Hidayat, 2015).

Figure 2: Similarities Between Korean & Indonesian Meals



Source: (Hidayat, 2015)

III. ANALYTICAL REVIEW

III.1. GLOBAL KOREAN WAVE

Korean Wave, known as well as Hallyu, is a phenomenon of the worldwide spreading Korean popular culture. Most of the time, music, magazine, newspaper or Internet that is initially introduced by Korean drama causes the mushrooming of Korean Wave. Korean drama changes the trend and interest of millions people throughout Asian communities around the world. Some successful Korean drama such as Winter Sonata and Endless Love were said to be the initiators of this wave, which then emphasized by Korean music bands that are also successfully capture consumers' interest. When this wave started to be something really hit, the Korean government did not let this opportunity slip through its fingers. The government took full advantage of this phenomenon and began promoting Korean entertainment industries in exporting Korean pop culture. This pop culture is treated as a commodity by Korean government since it plays also a big role in Korean economics (Ramadhani & Linadi, 2012).

III.2. GLOBAL AFFECT OF KOREAN POP CULTURE

Local Korean culture enthusiasts create also communities to keep learning and be update about their interest. Korean ambassador once formally invited some communities for a lunch as a gratitude for their positive support for the introduction Korean culture in Indonesia (The Jakarta Post, 2011). Korean wave does not stop there. It continually provides something new to people. Indonesians are also very keen on Korean boy and girl bands. By increasing demand, boy and girl bands live concerts start to be held in Indonesia and tickets are quickly sold out. Even though the digital music era is here, Korean music fans are still interested in having physical albums. Many Indonesians take this chance to open up some personal business of Korean music albums, trinkets and merchandises (Kartika, 2013).

Korean reality shows are also so much loved since it is interesting, funny and different from what local reality shows offer. Compared to Indonesian reality show that are mostly more conflict focused, Korean reality show are said to be more innovative and informative (Thresia, 2017). Asian magazines featuring Korean idol were something big back then and sold in bookstores nationally. Even though it is not that big anymore, fan-made books about their favorite Korean idol are now widely offered in bookstores. Korean fashion and beauty is also spreading worldwide including into Indonesia. The youthful look of Korean entertainers brought interest and wonders into the rise. A lot of Korean actresses look a lot younger than their actual age. Many people in result start to adopt Korean fashion style and make up look to their daily life (Shin, 2014).

Korean TV series initiate the passion to enjoy Korean genre – K-pop in Indonesia. Songs played during and after scenes trick Indonesians into liking Korean music, and that is how they get introduced to Korean entertainment world (Ani, 2015); the actors, actresses, singers, series and movies. The increase exposure draws the interest to give concerts in Indonesia, some that have are Rain, 2pm, Super Junior and SM-town. Music is not the only admittance that creates and grows the attentions of Indonesians to adore Korean entertainment. Indonesians admit Koreans are physically attractive. Charm that appears on every single face of the actors coins the sense of curiosity that soon develops into fancying (Shin, 2014).

Investing a lot of time in taking care of their skin, Koreans inspire the world as well about Korean skincare. Many non-Asians are appreciating the wonders of Korean skincare routine. With new products innovations, its preventive approach aligned together with the philosophy of natural ingredients is just one of many factors supporting Korean skincare success. Known to be high quality with lower price, Korean skincare introduced layering methods with more multiple products. Nonetheless, people love how Korean style skincare are formulated differently and maintain it in their daily regime (Shin, 2014).

IV. CONCLUSION AND RECOMMENDATIONS

South Korea and Indonesia have dated long in terms of trade, migration and overall influencing each other. Korean establishments in the capital of Indonesia have become rooted. Korean traditional restaurants are classified as the non-cheap dine outs where the targeted customers are supposedly Korean expats. While not all people are bothered to spend their nickel on a restaurant, consumers prefer to taste the similarity by purchasing the instant versions of some meals. Instant noodles are more than just a fad in Indonesia. It has rooted as a lifestyle, even more a national pride.

Proven that there are similarities between traditional Korean and Indonesian meal. The familiarity amongst these two groups would make a comfort zone that eventually needs no adaptation. Discussed earlier how daily meals have similar compositions, both nations are also amid fans of noodle. The presence of instant noodle is highly demanded, furthermore with additional range of spiciness. These two combined, are keen in fulfilling many Indonesian's interest. The fact that such similarity from Korean instant noodle is offered, the product itself is able to avoid market penetration simply to its familiar essence.

South Korea's success in penetrating worldwide market especially Indonesia isn't a short and instant story. Globalization intensifies foreign cultures transmitting in Indonesia. Government, businesses, and marketers definitely do hard works behind the gold. Through the changes of trends and interests, it is inevitable that products must remain competitive and apply changes or innovative ideas. For Korean Noodle itself, the launch could not be executed at a better time. Simultaneously with the Hallyu phenomenon, a launch of Korean instant noodle furthermore adds the hype accepted by significant portion of people. Spicy Korean noodle does not reflect the perfect product, but it became the perfect because it was introduced at the right place and the right time.

Spicy Korean noodles has never been bombarded its advertisements unlike the local version of instant noodles. The absences of advertisements for most products are seen as mishaps and step-back for product delivery. However, spicy Korean noodles seem to be in demand and are regularly stocked in supermarket with no advertisement in sight. This certainly has ticked all the Marketing Mix, including the promotion. The sellers conduct promotions of these Korean Noodles. It is seen how pricing strategies such

as bundle packages and Discounts are used to attract buyers, not advertisement of the product itself.

It can be concluded that the success of spicy Korean noodle is supported by the right timing, simultaneously introduced during the Hallyu phenomenon. Furthermore, it fulfills the local preference of providing both instant and spiciness under one package. Not to forget, that Korean culture has rooted decades in Indonesia (particularly in the capital city) hence the familiarity is no stranger to domestic citizens.

Numerous stakeholders can learn the success of spicy Korean noodle. No blatant advertisement, no excessive promotion yet its presence strongly prevails. As company spends significant funding on marketing and promotions, from the spicy Korean noodle can be learnt that launching product based on local preference is far more effective than introducing products to a new market. Inevitably it must include enough twist to make people curious in wanting to buy the product. Failure to do so, might seem the product as maturing and expected.

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CHAPTER 5

Strategic Ambiguity in Physiotherapy Service Identity: Implications for Value Proposition and Competitive Positioning of NK Health Clinics

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ABSTRACT

In recent years, the physiotherapy service sector in Indonesia has undergone tremendous growth, particularly in large urban centers, where private clinics, hospital-based rehabilitation units and multidisciplinary healthcare providers are increasingly competing for patients. In this context, physiotherapy organizations are increasingly under pressure to develop a defined service identity and deliver a differentiated value proposition to support sustained competitive positioning. Even with certified physical therapists, regular treatment processes and advanced therapeutic facilities, healthcare providers may face difficulties in harmonizing the internal perceptions of service identity with the exterior market positioning. This study intends to analyze the perceptions of the major stakeholders of physiotherapy service identity and how these perceptions influence the value proposition and competitive positioning of a physiotherapy-focused healthcare provider. The study used an interpretivist paradigm and a qualitative single-case study approach centered on NK Health Clinic. Data were acquired by document analysis and semi-structured interviews with management officials, physiotherapists and patients. The data were evaluated using thematic analysis to find patterns relating to service identity, value creation, perceptions of stakeholders and competitive positioning.

The results reveal that NK Health has a rather solid value proposition that is patient-centered, with communication, empathy, trust, comfort, and professional problem-solving being key components. Patients regularly reported favorable service experiences and high levels of trust in the clinic. The study also shows, however, that the stakeholders do not fully agree on the main service identity of the clinic. The organization's key service is popularly known to be Physiotherapy, however different groups of stakeholders highlight distinct areas of specialization such as musculoskeletal care, rehabilitation, pain management, neuro-musculoskeletal services, treatment of sports injuries and integrated care. This generates a degree of strategic ambiguity that could undermine the clinic's ability to articulate a clear market niche, in spite of its amazing service performance. The study finds that the difficulty for NK Health is not to provide patient value but to leverage its existing capabilities into a compelling and consistently conveyed service identity and positioning plan. These findings contribute to the emerging literature on healthcare service positioning and give practical implications for healthcare managers targeting improved organizational alignment, service differentiation and competitive positioning in increasingly competitive healthcare marketplaces.

Key Words: physiotherapy services, service identity, value proposition, competitive positioning, patient-centered care, strategic ambiguity.

1. Introduction

1.1 Background

The physiotherapy service business of Indonesia has had great growth in recent years, driven by the increasing public awareness of rehabilitation, musculoskeletal health, and preventative healthcare. The growing number of private physiotherapy clinics, hospital rehabilitation units and multidisciplinary healthcare providers has made the market more competitive, especially in big cities such as Jakarta. With customers being faced with more health care alternatives, physiotherapy providers are increasingly challenged to effectively express their unique value and to carve out a specific place in the marketplace. In the service sectors, a competitive advantage can no longer be built only on technical competence or clinical qualities. Organizations need to establish a compelling value proposition that describes why patients should select them above other options. Osterwalder and Pigneur (2010) define a value proposition as the set of benefits that are perceived by the client as significant and relevant. In healthcare contexts this premise extends beyond clinical outcomes to encompass patient experiences, quality of communication, trust, empathy and consistency of treatment. NK Health Clinic is a physiotherapy-based healthcare provider with several branches in the Greater Jakarta area. The firm has competent physiotherapists, standardized treatment protocols and sophisticated therapeutic equipment. But management faces a critical strategic dilemma on how the clinic should be positioned in the increasingly competitive physiotherapy industry. Internal talks reveal that there may be multiple interpretations of the clinic's principal service identity, competitive strengths, and long-term strategic focus by various stakeholders. The significance of this difficulty is further amplified by the fact that physiotherapy organizations often pursue competitive advantage through numerous positioning strategies, including specialization, patient-centered treatment, superior service delivery, technological innovation, accessibility, or holistic healthcare solutions. Without a well-articulated and regularly stated value proposition, firms may find it challenging to develop a distinctive market brand and strategy coherence across numerous branches. Thus, the present study intends to evaluate the perceptions of key stakeholders in NK Health on the clinic's physiotherapy services, to identify the value aspects highlighted in service delivery and to examine how these perceptions impact the competitive positioning of the clinic.

1.2 Problem Statement

NK Health has a number of physiotherapy services and operating branches but is faced with strategic concerns around service identity, differentiation strategy and competitive positioning. The business offers a broad range of physiotherapy treatments and is focused on patient-centered care, but it is unclear if there is a shared understanding among stakeholders of what the clinic's main value proposition is and how this value proposition is communicated to patients. It generates a requirement for a more profound organizational diagnostic of the understanding, delivery and positioning of physiotherapy services in the competitive healthcare market.

1.3 Objectives of the Study

The objectives of this study are to:

1. Explore how internal stakeholders characterize and define the identity of physiotherapy services at NK Health.
2. Identify important value characteristics of physiotherapy service delivery.
3. Assess patients' perceived value and lived experience of NK Health.

4. Assess the implications of these impressions for the clinic's competitive standing.
5. Formulate strategic proposals to improve the service brand and market position of NK Health.

2. LITERATURE REVIEW

2.1 Theory of Value Proposition

A value proposition is the package of benefits that an organization provides to customers in return for their choice and engagement. According to Alexander Osterwalder and Yves Pigneur (2010), a value proposition is the description of how an organization solves customer problems and produces real value that differentiates it from competitors. In the service sectors, value propositions are not only limited to actual outputs but also include experiences, connections, and perceived outcomes. The value propositions are significant in healthcare services as patients assess not only the clinical outcomes but also the quality of communication, trust, empathy, ease, and consistency of the service. Therefore, healthcare institutions compete not only on technical expertise, but also on the entire value that patients feel. A strong value proposition can assist physiotherapy providers express their service identity, connect internal stakeholders and build competitive positioning in increasingly competitive healthcare marketplaces.

2.2 Service Dominant Logic (SDL)

Vargo and Lusch (2004) introduced the Service-Dominant Logic, which claims that the value is not incorporated in the product or service itself, but it is co-created by the supplier and the client. In healthcare, value is generated through the partnership between practitioners and patients. Successful treatment depends on more than clinical knowledge. It depends on patient involvement, communication, trust and engagement throughout the care process. This opinion is especially applicable to physiotherapy services due to the fact that the outcomes of rehabilitation depend heavily on the constant contact of physiotherapists with patients. Thus, understanding the co-creation of value is vital when studying service identity and competitive difference.

2.3 Jobs to be done (JTBD)

Clayton Christensen and his colleagues designed the Jobs-to-Be-Done concept, which argues that customers "hire" products or services to complete a specific aim they have in their lives. They could be functional jobs, emotional occupations, and social jobs. Functional occupations are the functional results of a product, such relieving pain or regaining movement. Jobs that include feelings of reassurance, confidence and peace of mind are emotional jobs. Social occupations refer to one's ability to resume valuable social responsibilities and activities. In physiotherapy settings, patients often look for more than just symptom treatment. They may also be seeking confidence in recovery, professional advice, emotional support and the ability to get back to normal day-to-day activities. Understanding these underlying jobs helps healthcare practitioners to design value packages better aligned with patient wants and expectations.

2.4 Competitive Positioning

"Competitive positioning is how an organization positions itself to be unique in its market with respect to its competitors" (Michael E. Porter, 1985). Thus, competitive positioning in healthcare services can be expressed through specialization, service quality,

patient experience, reputation, accessibility or clinical knowledge. In this study, competitive positioning is explored through a number of observable factors, including perceived specialty, service consistency, patient referral preference, brand awareness, and perceived distinction from competing physiotherapy providers. These indicators give a pragmatic view of NK Health's position in the physiotherapy market and if its value offer is adequately differentiated and consistently articulated.

2.4 Conceptual Framework

This study employs a qualitative organizational diagnosis perspective to explore the way in which physiotherapy services are understood, evaluated and positioned in NK Health Clinic. The paradigm does not assume that organizational members share a common concept of the service identity, but rather recognizes that the various stakeholder groups may have varied interpretations of the clinic's purpose, strengths, and competitive advantages. The framework starts with stakeholder interpretations. These are the views of key players inside and outside the organization regarding physiotherapy services at NK Health. These stakeholders comprise management, physiotherapists and patients. Management may focus on strategic objectives and corporate values, physiotherapists may focus on clinical practice and service delivery and patients may assess services based on their experiences, outcomes and expectations. The service-intensive nature and reliance on human interactions of healthcare organizations could affect service delivery and understanding through disparities in stakeholder perspectives. The service identity is formed by the interpretations of these stakeholders. Service identity is the way the organisation identifies and offers its physiotherapy services – the areas of expertise, the service emphasis and the specific features that set the clinic apart from rivals. A well-defined service identity gives direction to service delivery and assists firms in consistently communicating their mission to internal and external stakeholders. Conversely, contradictory interpretations might cause ambiguity as to what the organization stands for and how it should be positioned in the market. Later, service identity is used as the basis for the organization's value proposition. The value proposition, based on Value Proposition Theory and the Jobs-to-be-Done perspective, describes the unique benefits that patients obtain from the utilization of physiotherapy services. Benefits can include functional outcomes (e.g. pain reduction, enhanced mobility), emotional outcomes (e.g. reassurance, confidence) and relational outcomes (e.g. trust, empathy and long-term therapy partnerships). The value proposition thus provides the practical translation of service identity into meaningful value for patients. Finally, the value proposition affects competitive positioning. Competitive Positioning: How NK Health is positioned against other physiotherapy providers in the market. The study examines competitive positioning through factors such as perceived specialty, differentiation of services, consistency of service delivery, patient preference and general perception of the market. A clear and consistent understanding of the value proposition may improve competitive positioning, whereas ambiguity or inconsistency may constrain the organization's capacity to differentiate itself from its competitors. Crucially, the paradigm does not presume a linear or totally aligned process. The differences between management, physiotherapists and patients may expose areas of tension, inconsistency or strategic ambiguity. As such, the study aims to examine how these multiple interpretations interact and how they together shape the evolution of NK Health's physiotherapy service identity, value proposition and competitive positioning.

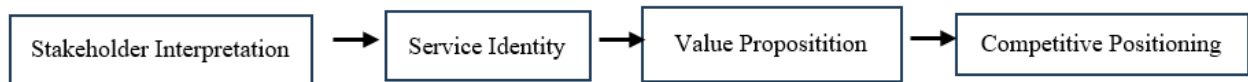


Figure 1. Research Conceptual Framework

3. RESEARCH METHODOLOGY

3.1 Research Approach

The study is qualitative interpretivist in methodology and uses a single-case study design.

This study aims to explore how stakeholders evaluate the identity and value proposition of physiotherapy services at NK Health Clinic.

3.2 Research Location

NK Health Clinic outlets throughout Greater Jakarta

3.3 Research Participants .

Inside stakeholders:

- Physiotherapist, MA
- Physiotherapist, MO
- Physiotherapist, YR
- Management of Physiotherapy, FTR

External stakeholders:

- DM, Patient
- Yny, Patient

3.4 Data Collection

Review of Documents

- About the company
- Vision and mission
- SOP
- Service info

Semi-Structured Interviews

Six participants were interviewed with the use of an interview guide generated from:

- Theory of Value Offering
- Service Dominant Logic
- Jobs-to-be-Done
- Competitive positioning”

3.5 Analysis of data

Data were examined using theme analysis as described by Braun and Clarke (2006) .

The analytical process included:

1. Data familiarisation
2. First coding
3. Theme evolution
4. Theme review
5. Discussions

NVivo software was utilized to aid coding, categorization and themes development.

4. RESULT AND DISCUSSION

The findings can be classified into four main areas.

4.1 Various Readings of the Physiotherapy Identity of NK Health

The interviews reveal that the common understanding of NK Health is that of a physiotherapy clinic, although the interpretation of the physiotherapy identity is not totally consistent. Some physiotherapists say that NK Health is strongest in musculoskeletal cases, rehabilitation, pain treatment and sports injury.

treatment on the other hand sees the clinic as having an integrated service orientation with patient-centered care as the key value. But patients like to define NK Health more simply as a rehabilitation or pain management clinic based on their personal experience of healing. This finding demonstrates that NK Health does not suffer from a total lack of identity. Instead, the issue is partial ambiguity. Internally the strategy focus may not always be the same despite an understanding by stakeholders that physiotherapy is the key service. This confirms the examiner's proposal that the study should not assume organizational coherence, as healthcare organizations may have various interpretations among management, therapists and patients.

4.1.1 Physiotherapy Identity as a Multi-Interpreted Concept

Figure 2 shows the NVivo relationship map developed from coding of the interviews on physiotherapy identity. The analysis shows that the physiotherapy identity of NK Health is not defined by a single major dominant specialism. Rather, stakeholders link the clinic to a wide spectrum of service categories, including musculoskeletal care, neuromuscular care, orthopedics, pain management, rehabilitation, sports injury management, wellness, and general physiotherapy services. The musculoskeletal care, rehabilitation, pain management and neuromuscular services are most commonly cited categories across responders. Musculoskeletal disorders were the most common patient case and rehabilitation and pain treatment were common to everyday clinical practice, as reported by physiotherapists regularly. Management similarly recognized wide physiotherapy talents, but also pointed to the absence of a distinct expertise. Patients, in contrast, based on their own experience, linked NK Health mostly with rehabilitation, recuperation, and treatment of pain. An noteworthy finding of the map is the coexistence of two opposing narratives about identity. The first narrative presents NK Health as a complete physiotherapy provider that can treat a wide variety of patient ailments. The second story highlights the clinic's greater experience in services connected to musculoskeletal and rehabilitation. These narratives do not reinforce each other, but rather produce some level of strategic uncertainty about what NK Health should be known for in the marketplace. This is an important result since it shows not that the organization does not have the service capability. The problem, rather, is to translate numerous service capabilities into a consistent and distinct service identity. Broad service coverage may increase operational flexibility and patient accessibility, but may also decrease distinction if external stakeholders cannot identify the clinic's core focus. From a competitive positioning perspective, the map shows that stakeholder interpretations are still spread over numerous service categories, and are not merging into a dominant brand. This pattern supports the thesis that the strategic problem for NK Health is not clinical performance per se, but the articulation and communication of a targeted value proposition. Consequently, the future positioning strategy for the organization may need to find a compromise between providing a whole range of physiotherapy capability and a clearer specialization in its core areas of expertise, particularly musculoskeletal rehabilitation and pain management services.

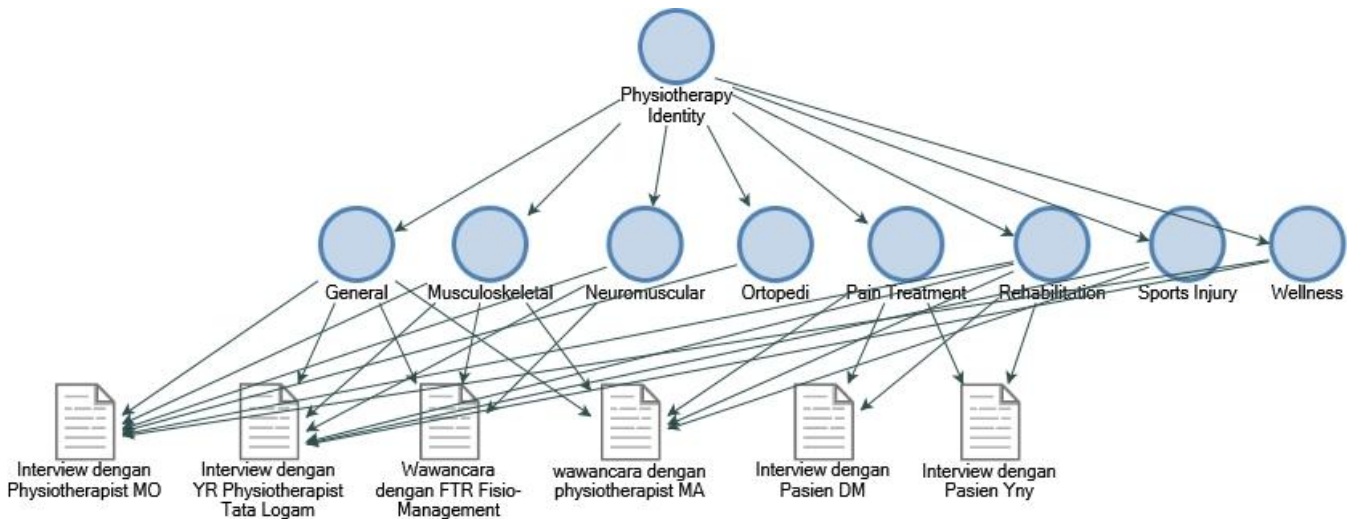


Figure 2. Physiotherapy NK Health's Identity from Respondents Views

4.2 Patient-Centered Service as Value Proposition Experienced

Patient-centered service is one value factor that strongly surfaces across the interviews. Repeatedly physiotherapists and patients stress communication, explanation, kindness, empathy, comfort and trust. The patients enjoy that the physiotherapists explain their condition in a clear way, listen to patients' concerns and provide extensive instructions throughout therapy. It shows that the real value proposition of NK Health does not rest on equipment, clinical treatment or technological skill. The strongest value reported by patients is the blend of professional problem solutions and relationship care. In other words, patients are not only 'buying' physiotherapy treatment, they are looking for reassurance, explanation, confidence, recuperation and emotional support during the healing process.

This discovery is in strong agreement with Service-Dominant Logic and the Jobs-to-Be-Done framework. Value is co-created in the relationship between physiotherapist and patient. Functional jobs include pain relief, mobility improvement, and rehabilitation. Emotional jobs are feeling protected, heard, reassured, confident. Relational jobs involve trust in the physiotherapist and readiness to return or suggest the clinic.

4.2.1 Dominant Value Proposition of Patient-Centric Service

Figure 3 NVivo relationship map from interview coding on patient-centered service. The data suggests that patient-centred treatment is the most commonly shared value between management, physiotherapists and patients. Respondents consistently tied NK Health to the interpersonal and relational aspects of care, rather than to equipment, technology, or clinical specialty alone. This patient-centered approach has several mixed components, such as communication, extensive explanation, thorough assessment, empathy, hospitality, comfort, problem-solving skills, and trust. These variables are correlated across several stakeholder groups, showing a rather high degree of alignment around the value that NK Health brings to patients. Among these qualities, communication and full explanation appear to be especially relevant. Both patients and physiotherapists stressed the importance of helping patients understand their disease, the process of treatment, the expected outcomes, and the path to recovery. This shows that patients value not only the therapy action itself but also the knowledge and reassurance gained from the treatment process. In healthcare services, as there is often uncertainty associated with disease and recovery, effective communication becomes a key source of perceived value. The map also points out the value of empathy, hospitality and comfort. Throughout their treatment experience, patients consistently said they felt welcomed, cared for, and understood. These results show that physiotherapy services at NK Health are more than technical rehabilitation but include creating a supportive therapeutic atmosphere. Experiences like this add to the emotional value that competitors often find hard to equal with equipment or clinical standards alone. Another key finding is the strong link between trust and problem-solving ability. Respondents generally

perceived physiotherapists as professionals who provide therapy but also discover underlying issues, explain remedies and coach patients to recovery. This tendency emphasizes the notion that confidence is not built by simply having the correct qualifications but by continually exhibiting knowledge, responsiveness and a personal touch. As a result, patients develop confidence in the physiotherapist and the organization. These findings show that value is co-created through continuous interactions between physiotherapists and patients from a Service-Dominant Logic perspective. The value NK Health brings is not only in the therapeutic processes; it's in the total service experience – communication, empathy, assessment, education, and collaborative problem-solving. These findings indicate that patients are seeking more than functional goals such as pain reduction or physical rehabilitation from a Jobs-to-Be-Done perspective. They also desire emotional outcomes, such as reassurance, confidence, comfort and trust. NK Health's value offer therefore looks to be multimodal, combining clinical effectiveness with a highly relational, patient-centered service experience. Most importantly, unlike the earlier NVivo map on physiotherapy identity, this map displays a higher degree of stakeholder convergence. While there was some variation among respondents about what NK Health should be known for strategically, there was remarkable uniformity in how value is delivered to patients. This shows that the main organizational strength of NK Health may not be a particular clinical specialty but instead a patient-centered service culture of communication, empathy, trust, and professional problem solving. These aspects are therefore the basis to elaborate a clearer and more unique competitive positioning plan.

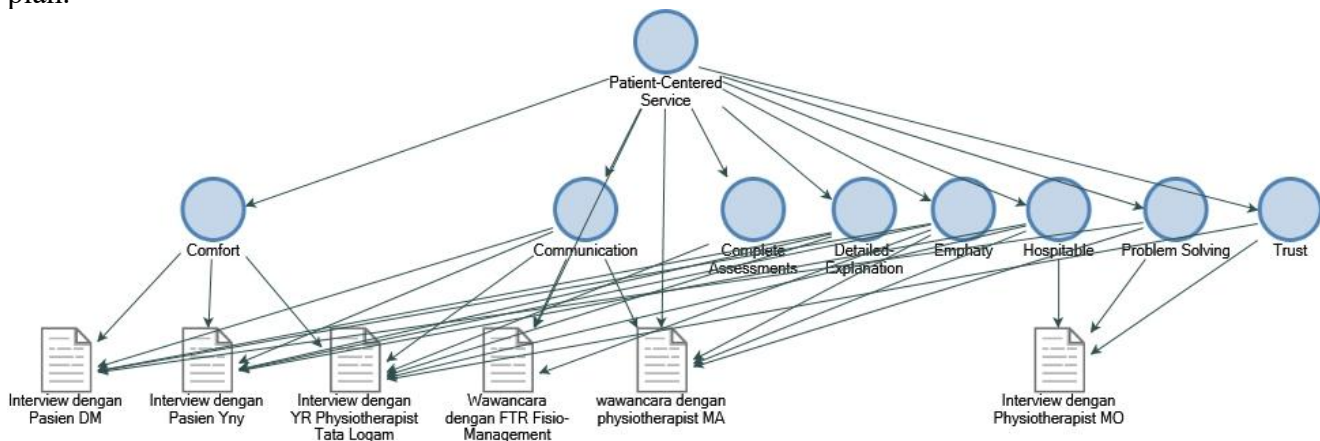


Figure 3. Patient-Centered Services from Respondents Views

4.3 Generalist Ability versus Specialist Positioning
 There seems to be a huge strategic tension between the vast competence of NK Health and its need for clearer positioning. Several respondents say NK Health can manage a wide range of physiotherapy situations including musculoskeletal, neurological, geriatric, pain-related and sports-related cases. However, several physiotherapists also say that the strongest area for NK Health is musculoskeletal or neuro-musculoskeletal care.

This creates a strategic ambiguity: NK Health wants to be able to serve various instances, while the market may need a more precise messaging about what the clinic is notably recognized for. While being “able to handle many things” may assist operational flexibility, it can decrease outward differentiation if patients are not able to clearly grasp the clinic’s strongest identity. It’s not a question of whether NK Health should be focused or broad. The larger challenge is how NK Health can express a strong core identity and provide greater service capacity. One suggested positioning orientation may be: “patient-centric physiotherapy with strong neuro-musculoskeletal rehabilitation expertise”.

4.3.1 Reasons for Strategic Ambiguity and Positioning Problems
 The NVivo connection map in Figure 4 was developed by coding the interviews on organizational problems and perceived challenges to enhanced market positioning. Respondents noted various associated difficulties

on the map, including branding, marketing communication, unclear specialization, technology, SOP uniformity, facility differences, patient uncertainty, and price-related concerns. Another big problem is uniformity and the difference in facilities from branch to branch. Management and physiotherapists noted generally the existence of comparable service protocols but variances in facilities, equipment availability and branch infrastructure were acknowledged. These discrepancies may not have a direct impact on clinical quality, but may impact patient perception of service consistency across locations. In multi-branch healthcare businesses, consistency is a key factor in company identity and competitive positioning.

Technology was also stressed as a strategic issue, especially in regard to the assessment capacities and modernization of physiotherapy services. “A number of competitors are beginning to deploy more sophisticated assessment technologies and this is putting pressure on NK Health to continue to improve its service offerings,” the respondents said. But technology appears to be a secondary worry, compared to the branding and positioning challenges. Interestingly, disorientation in patients was an effect, not a cause. Results reveal that patients are not confused about the quality of care they receive but rather are confused about the major purpose and strategic emphasis of the clinic. This observation lends further credence to the thesis that the problem at NK Health is not the absence of value creation but the articulation of a clear and distinctive organizational identity. Collectively, these data show that NK Health’s competitive positioning issues stem more from strategy ambiguity than from operational inadequacy. The organization has strong patient-centred care delivery and good patient experiences, but those characteristics have not been turned into a sufficiently defined market brand. Thus, the core managerial challenge is not about boosting clinical performance but about translating existing organizational assets into a clear and constantly articulated positioning strategy.

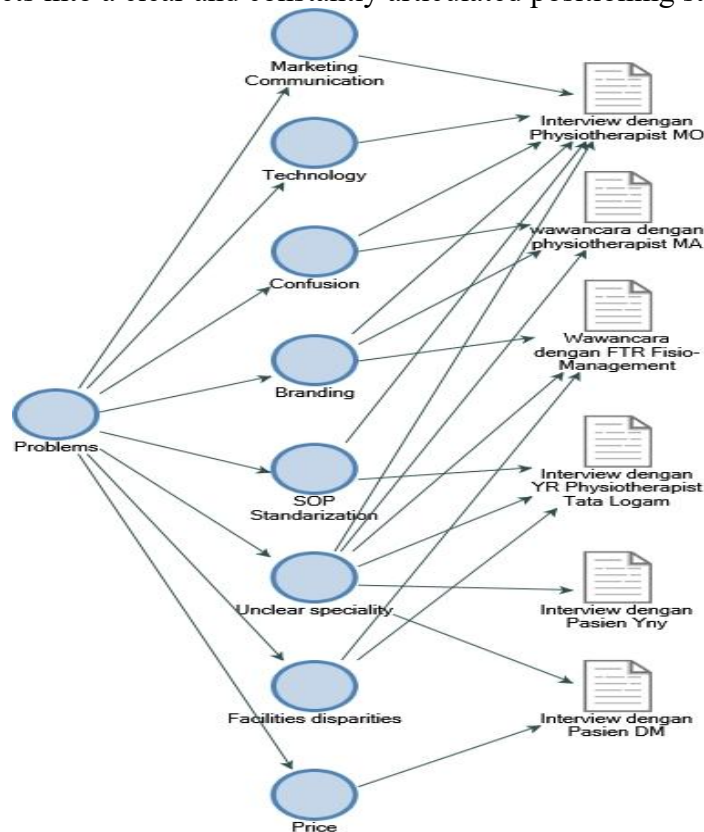


Figure 4. The Clinic’s Problem

4.4 Communication Deteriorates Competitive Positioning More than Service Quality

The interviews reveal that the service quality of NK Health is generally rated positively. Patients talk of friendliness, comfort, skilled therapists, detailed explanation, happy to suggest the clinic. However,

numerous internal respondents identified branding, marketing communication, social media, facility disparities, and unclear specialty as big problems. This may suggest that the competitive problem for NK Health may not be clinical weakness per se. The problem is not internal service quality but the gap between internal service quality and outward market communication. The clinic may already be providing real value to patients, but that value is not yet converted into a crisp and consistent market message. Thus, NK Health's competitive positioning should be diagnosed by three indicators: first, whether stakeholders can clearly describe the clinic's service identity; second, whether patients can recognize the distinctive value of the clinic; and third, whether this value is consistently communicated across branches and marketing channels.

5. Conclusions, Recommendations and Limitations

5.1 Conclusions

The study reveals that the patient-centered value proposition of NK Health is that it is relatively strong and consistent in that stakeholders perceive the quality of communication, empathy, trust, comfort, full explanations, and professional problem-solving. Patients regularly expressed favorable experiences of care and reported high levels of satisfaction, trust and willingness to recommend the clinic to others. The data indicate that NK Health has been effective in producing substantial value for patients in addition to clinical treatment results alone.

However, the analysis also shows that the physiotherapy service identity of the clinic is still only partially consolidated. There is no consensus on how to identify the clinic's main area of competence, but physiotherapy is the main service provided at NK Health according to the stakeholders. Management and physiotherapists emphasise different aspects of musculoskeletal care including rehabilitation, pain management, neuro-musculoskeletal services, treatment of sports injuries, integrated services and patient-centred care. As a result, the organization puts forth a number of identity narratives instead of a single dominant positioning topic.

The results reveal that the main strategic issue for NK Health is not the quality of its physiotherapy services, but strategic uncertainty about how to express and convey its assets to the market. While the clinic delivers a solid patient-centered care experience, this value has not yet been transformed into a focused and differentiated enough market brand. This could result in a mismatch between the internal service quality and the external market positioning, which may impact the clinic's ability to improve brand awareness and competitive differentiation in the increasingly competitive physiotherapy landscape.

The analysis indicates that NK Health's future competitive advantage resides not in developing new value but in clarifying, consolidating and articulating the value it is presently providing. A more clearly defined service identity, supported by a regularly communicated positioning plan, could help the clinic to leverage its current strengths into a stronger and more unique competitive position.

5.2 Recommendations

From the findings, some recommendations are made for NK Health Clinic.

Firstly, NK Health should build a clearer and more targeted physiotherapy positioning strategy. Instead of trying to be recognized equally throughout all physiotherapist service categories, the business should choose those service areas that best reflect its expertise and market capabilities. The results imply that musculoskeletal rehabilitation, pain treatment and neuro-musculoskeletal care may give the most compelling rationale for a unique positioning strategy.

Second, NK Health has to transform its patient-centered service culture into a formal value proposition statement that can be regularly articulated internally and externally. The company already exhibits good skills in communicating, empathy, developing trust and solving problems. These attributes should be explicitly part of the clinic's brand identity, not solely embedded in day-to-day care delivery.

Third, management should increase organizational alignment on service identity. While clinical protocols and service standards look largely constant, stakeholders continue to identify the clinic's specialism in varied ways. Thus, internal trainings and strategic communication activities should not only focus on service

delivery standards, but also on building a common understanding of what NK Health stands for and how it should be positioned in the market.

Fourth, NK Health should strengthen the consistency of its external communications and branding initiatives. Marketing needs to move beyond generic health education and express a more specific message about the clinic's expertise, the needs of its target patients and its unique approach to service. A more targeted communication approach could help to eliminate patient ambiguity about the clinic's specialism and enhance public perception of its competitive capabilities.

Finally, NK Health should build patient experiences into the company's strategic assets. The interviews show that trust, comfort, recovery experiences, therapist explanations and personalized care are among the most valued components of the service. These experiences can be used in testimonials, case stories, patient engagement efforts and brand communication activities to strengthen the clinic's positioning and promote lasting patient loyalty.

5.3 Limitation

There are limitations to the study. Firstly, it is a case study of one case, NK Health, and the findings cannot be extrapolated statistically to all physiotherapy clinics. Second, the number of respondents is modest, but the interviews provide valuable information into the internal and patient viewpoints. Third, there are just two patients representing the patient perspective. Future research may include a larger number of patients from other branches and service categories. Fourth, the study is mostly centered on stakeholder interpretation and lacks direct competitor interviews or quantitative market data so far. Thus, the findings should be taken as a strategic organizational diagnosis rather than a thorough market-positioning measurement.

6. Acknowledgments

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CHAPTER 6

The Effect of Digital Literacy, Platform Support, Time Management, and Social Support to Effectiveness of Affiliate Marketing for Mothers in Java Island

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ABSTRACT

This study examined the determinants of affiliate marketing effectiveness among mothers in Java, focusing on digital literacy, platform support, time management, and social support within a trust-driven digital environment. Using a quantitative design and Partial Least Squares Structural Equation Modeling, survey data from active affiliate marketers were analyzed to test the proposed relationships. The results show that digital literacy and platform support significantly enhance affiliate marketing effectiveness, while time management and social support do not demonstrate direct significant effects. The measurement model confirms satisfactory reliability and validity, and the structural model indicates substantial explanatory power. The findings highlight that affiliate marketing performance is primarily shaped by technological competence, content optimization, and effective use of platform tools that strengthen credibility and audience trust. Authentic communication, data-informed content strategies, and transparent engagement practices emerge as critical drivers of sustainable affiliate outcomes. The study contributes to the understanding of how trust and authenticity, supported by digital capability, underpin effective affiliate marketing in emerging digital economies.

Keywords: Digital Literacy, Platform Support, Affiliate Marketing, Trust And Authenticity

INTRODUCTION

Indonesia's economy has recently put pressure on household financial stability, especially for middle- and lower-income families. Rising living costs, income fluctuations, and limited access to stable jobs have weakened household resilience and led families to look for alternative income sources (Badan Pusat Statistik, 2024). In response, micro-entrepreneurship has quickly grown as a strategy for survival and making ends meet. Digital platforms and mothers have been key in this shift, allowing income generation without requiring large investments or formal employment setups while fulfilling caregiving duties and household roles (International Finance Corporation, 2022; EdelGive Foundation, 2021).

The rise of e-commerce and social commerce has further boosted women's involvement in digital entrepreneurship (Google, Temasek, & Bain & Company, 2023). These platforms have lowered entry barriers for micro and small businesses. Affiliate marketing has become an easy path for digital income by promoting products without handling inventory or logistics (Rahman, Alam, & Wahid, 2024).

However, the results of affiliate marketing among mothers are still very inconsistent. Previous research indicates that digital skills, platform usability, and access to helpful resources impact online business outcomes. These factors are often not evenly distributed among women entrepreneurs (Hendratmi, Agustina, & Sulungbong, 2022).

The goal of this paper was to look at factors such as digital literacy, platform support, time management, and social support affect effectiveness in affiliate marketing. Based on Social Influence Theory and similar behavioral perspectives, the study highlighted how individual abilities and platform environments shape performance in social commerce settings (Kelman, 1958; Gao, Yu, & Zhang, 2023). Researchers collected primary data from 150 mothers using structured questionnaires and analyzed the results with Partial Least Squares Structural Equation Modeling.

1. LITERATURE REVIEW

Affiliate marketing is widely seen as a convenient way to earn money online. This is especially true in marketplace-based e-commerce systems, which lower capital and operational costs (Rahman, Alam, & Wahid, 2024). However, evidence shows that taking part does not always lead to positive results. Individual skills, platform conditions, and context all play a role in shaping performance (Park & Burford, 2023; Dewi, 2024). Most existing studies tend to look at these factors one at a time, making it hard to understand how they work together to affect affiliate marketing success for mothers.

1.1 Digital Literacy (H1)

Digital literacy is a key skill for digital entrepreneurship. It includes the technical, thinking, and analytical skills needed to create content, use platforms, and understand performance metrics (Park & Burford, 2023). Previous studies show that women with higher digital literacy have more confidence, flexibility, and better online business results (Rahman et al., 2024). In affiliate marketing, digital literacy helps with persuasive communication and building trust in social commerce settings (Devyantza, 2025). However, few studies directly connect digital literacy to affiliate marketing success among mothers. This supports H1.

1.2 Platform Support (H2)

Platform support includes tools, training resources, analytics dashboards, and user-friendly interfaces that help with affiliate activities (Rahman et al., 2024). Research shows that accessible platform design reduces operational complexity and improves engagement, especially for users with limited digital experience (Park

& Burford, 2023). For mothers, effective platform support encourages continued participation by lowering cognitive and technical barriers (Dewi, 2024). The limited empirical focus on platform support as a driver of performance backs up H2.

1.3 Time Management (H3)

Time management is still a major challenge for mothers who juggle caregiving and work (Amalia & Rahardjo, 2021). Structured routines and scheduling can lead to better productivity and emotional health. However, the evidence on how these factors directly affect affiliate marketing performance is mixed (Dewi, 2024). This uncertainty points to the necessity of testing H3.

1.4 Time Management (H4)

Social support, which includes emotional, informational, and peer-based help, is crucial for keeping women engaged in digital entrepreneurship (Doherty, 2020). Communities of peers and encouragement from family boost motivation and resilience. However, their direct impact on performance outcomes has not been thoroughly studied (Rahman et al., 2024; Devyantza, 2025). This gap supports H4.

1.5 Effectiveness of Affiliate Marketing

Affiliate marketing effectiveness encompasses economic and psychological outcomes, shaped by persuasion, trust, and perceived capability (Kelman, 1958; Bandura, 1986). Integrating Social Influence Theory and Social Cognitive Theory, this study conceptualizes effectiveness as the result of interactions between digital literacy, platform support, time management, and social support. These relationships are illustrated in Figure 1 below.

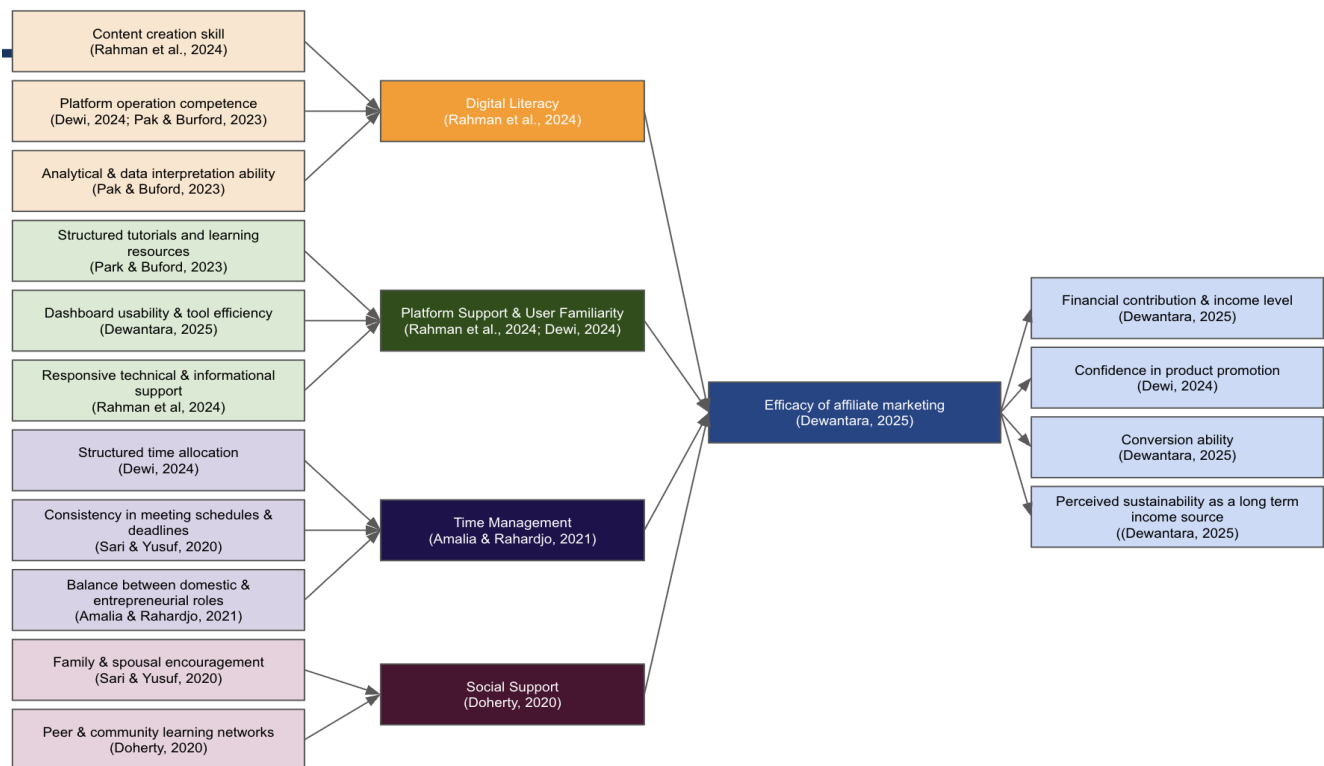


Figure 1. Theoretical Framework
Source: Authors (2026)

2. RESEARCH METHOD

This study used a quantitative research method to look at how effective affiliate marketing is among mothers on Java Island, Indonesia. The research focused on four questions: Did digital literacy influence the

effectiveness of affiliate marketing? Did time management affect mothers' ability to participate consistently in affiliate marketing? Did platform support features, like training resources and tools, impact effectiveness? And did social support from family and peers enhance affiliate marketing effectiveness? A quantitative approach was suitable because it allowed for structured testing of hypotheses and the estimation of causal relationships.

Primary data were collected through an online questionnaire. A non-probability purposive sampling method was used. Respondents had to be mothers living on Java Island, actively engaged in affiliate marketing on major platforms, and must have achieved at least one outcome, such as a commission or conversion. This ensured the data were relevant. A total of 150 valid responses were gathered, meeting the recommended minimum sample size for Partial Least Squares Structural Equation Modelling.

All constructs were measured using multi-item indicators on a five-point Likert scale. Digital literacy included skills in content creation, platform operations, and data interpretation. Platform support included access to learning resources, usability of dashboards, and technical help. Time management assessed structured time allocation and consistency in scheduling, while social support looked at family encouragement and peer learning networks. Affiliate marketing effectiveness was gauged by financial contributions, confidence in promoting products, conversion ability, and perceived sustainability as a long-term income source.

Data analysis was conducted using Partial Least Squares Structural Equation Modeling with SmartPLS software. This method was chosen because it works well for predictive research with multiple latent constructs and moderate sample sizes. The evaluation of the measurement model followed established standards, with composite reliability values above 0.70 and average variance extracted above 0.50. Structural relationships were tested using bootstrapping methods, with hypotheses supported when t-values were above 1.65 and p-values were below 0.05.

3. RESULT AND DISCUSSION

3.1 Respondent Profile and Data Adequacy

Data were collected from 150 mothers actively engaged in affiliate marketing in Java Island, representing a sufficient and appropriate sample size for PLS-SEM analysis. Respondents were predominantly aged 25–34 years, indicating that affiliate marketing participation is strongest among mothers in early to mid-working age. Geographically, respondents were distributed across major provinces in Java, with higher concentrations in West Java, East Java, and DKI Jakarta, reflecting regions with stronger digital infrastructure and platform penetration.

Most respondents reported ongoing affiliate activity and experience across multiple platforms such as TikTok Shop Affiliate and Shopee Affiliate. This confirms that the sample consists of active practitioners, supporting the relevance and external validity of the findings.

3.2 Hypothesis Testing and Structural Discussion

The results of the hypothesis testing are summarized in Table 1 (Hypothesis Testing Results).

Table 1. Hypothesis Testing Results

Hypothesis	Structural Path	Path Coefficient (O)	T-statistic	P-value	Effect Size (F)	Decision	Strength
H1	Digital Literacy → Effectiveness of Affiliate Marketing	0.416	4.104	0.000	0.244	Supported	Moderate
H2	Platform Support → Effectiveness of Affiliate Marketing	0.380	5.386	0.000	0.181	Supported	Moderate
H3	Time Management → Effectiveness of Affiliate Marketing	0.123	1.592	0.112	0.026	Not supported	Small
H4	Social Support → Effectiveness of Affiliate Marketing	0.056	0.686	0.492	0.005	Not supported	Very weak

Note: A hypothesis is supported when p-value < 0.05.

Source: Authors (2026)

The bootstrapping analysis shows that Digital Literacy has a positive and statistically significant effect on Affiliate Marketing Effectiveness ($\beta = 0.416$, $p < 0.001$), with a moderate effect size. Platform Support also has a significant positive impact ($\beta = 0.380$, $p < 0.001$), confirming that system-level features improve performance outcomes. In contrast, Time Management ($\beta = 0.123$, $p = 0.112$) and Social Support ($\beta = 0.056$, $p = 0.492$) do not show statistically significant direct effects. While these variables are still conceptually important, the results indicate that measurable affiliate performance primarily depends on capability-based and platform-enabled factors rather than time management or social support alone. This suggests that technical skills and how easy the platform is to use are key factors in the model.

Overall, combining a confirmed measurement model with clear structural paths shows that affiliate marketing effectiveness in digital settings depends on skill use and system setup. This highlights that generating stable digital income needs to strengthen both individual digital skills and the support provided by the platform, rather than just focusing on participation or motivation.

3.3 The Effect of Digital Literacy on Affiliate Marketing Effectiveness

The findings show that digital literacy is key to improving affiliate marketing effectiveness. People with stronger digital skills can choose relevant products better, improve content formats, understand engagement metrics, and adjust strategies based on performance data.

From a structural viewpoint, digital literacy boosts efficiency in platform-based environments. Here, factors like algorithm visibility, content ranking, and audience targeting influence results. Affiliate marketing relies on digital systems that reward skill-based optimization instead of just effort. This is why digital literacy was

the strongest predictor in the model.

From a policy perspective, this finding directly affects government digital economy programs. Simply increasing access to platforms is not enough. Developing structured digital skills, including data literacy, content strategy, and understanding algorithms, is essential for creating sustainable digital income. Government training efforts should focus on skill-intensive programs that are relevant to the platforms used, rather than just raising awareness.

3.4 The Effect of Platform Support on Affiliate Marketing Effectiveness

Platform Support also demonstrates a significant positive effect on affiliate marketing performance. The results indicate that well-designed dashboards, learning modules, algorithm clarity, and responsive assistance reduce operational friction and enhance user performance.

Affiliate marketing is embedded within system-based digital ecosystems. When platforms provide intuitive tools and structured guidance, affiliates can focus on strategic content creation rather than technical troubleshooting. The positive effect of platform support confirms that system readiness complements individual capability.

For government stakeholders, this highlights the importance of ecosystem collaboration. Public policy aimed at strengthening digital entrepreneurship should involve partnerships with platform providers to ensure accessible training modules, localized learning resources, and simplified performance tools. Sustainable digital income programs require alignment between user capability and system affordances.

3.5 The Role of Time Management and Social Support

Although Time Management and Social Support are often considered important in entrepreneurial activity, the findings show that neither variable has a statistically significant direct effect on Affiliate Marketing Effectiveness in this model.

Time Management may function more as a sustaining or moderating factor rather than a direct driver of measurable performance outcomes such as conversion or commission generation. Similarly, Social Support may contribute to motivation, emotional resilience, or participation continuity, but it does not automatically translate into performance gains without accompanying digital competence and platform readiness.

These results reinforce the structural nature of digital markets. Performance in affiliate marketing is influenced more strongly by execution quality and system integration than by effort allocation or relational encouragement alone.

CONCLUSION

This study examined the factors influencing affiliate marketing effectiveness in a digital environment, focusing on Digital Literacy, Platform Support, Time Management, and Social Support. The findings confirm that Digital Literacy and Platform Support have significant positive effects on affiliate marketing effectiveness, while Time Management and Social Support do not demonstrate direct significant impacts. These results indicate that affiliate marketing success is primarily driven by technical skills and system support rather than contextual or relational factors alone.

Beyond structural determinants, the study highlights the central role of trust and authenticity in affiliate marketing. Unlike traditional advertising, affiliate marketing relies heavily on genuine testimonials, personal experiences, and relatable communication. Audiences are more likely to respond to content that reflects authentic product use and credible storytelling, particularly in categories such as health, baby products, and household-related goods.

The positioning of affiliate marketing within the broader influencer ecosystem is illustrated in Figure 2 (Influencer Classification Matrix). The matrix shows that affiliate marketers operate in a quadrant characterized by high perceived authenticity and performance-based orientation, often with lower brand control compared to brand ambassadors or sponsored influencers. This relative independence strengthens audience trust and enhances persuasive impact.

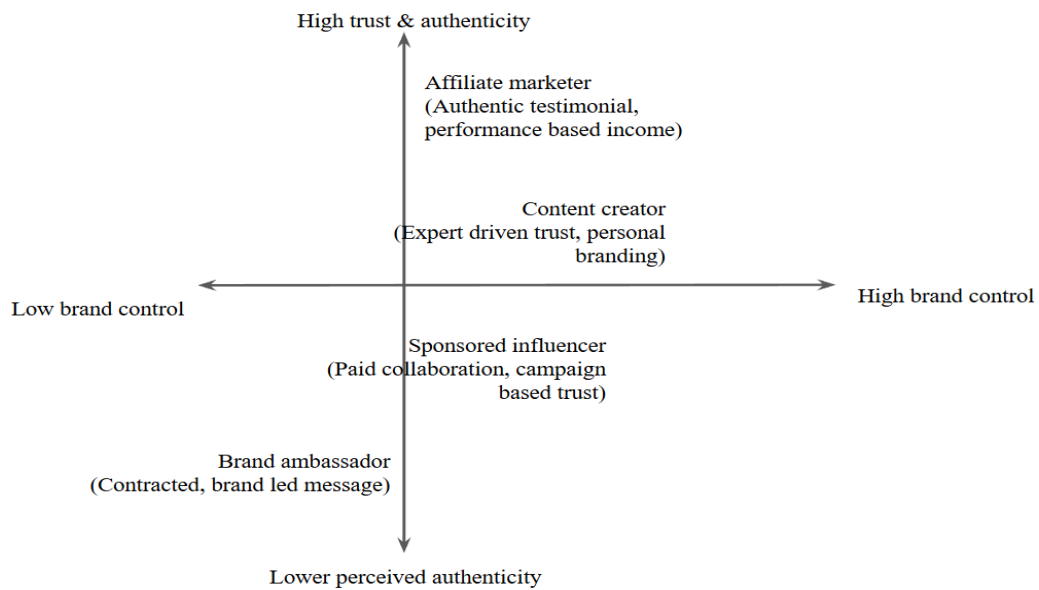


Figure 2. Influencer Classification Matrix
Source: Authors (2026)

Overall, affiliate marketing effectiveness lies at the intersection of digital capability, platform readiness, and authentic relationship-building. Strengthening technical skills and enabling flexible, trust-based content creation are therefore critical to achieving sustainable performance in digital affiliate ecosystems.

RECOMMENDATION

The findings of this study open several directions for future research and provide practical implications for the affiliate marketing ecosystem. From a research perspective, future studies should broaden the range and diversity of respondents by including participants from other regions of Indonesia and varied socio-economic backgrounds. Expanding geographic and demographic coverage would improve the generalizability of findings and allow for comparative analysis across different levels of digital infrastructure and platform maturity. In addition, incorporating objective performance indicators such as click-through rates, conversion rates, and commission earnings alongside self-reported measures would strengthen causal inference and reduce potential response bias. Longitudinal and mixed-method research designs are also recommended to examine how digital literacy, platform support, and engagement evolve over time, and to explore whether time management and social support exert indirect or moderating effects on long-term

sustainability rather than immediate performance outcomes.

From a practical standpoint, affiliate practitioners are encouraged to focus on strengthening digital literacy rather than increasing time spent on affiliate activities. The results suggest that performance gains are driven by the ability to create effective content, utilize platform features efficiently, and interpret performance metrics accurately. Regular engagement with analytics dashboards and platform feedback mechanisms enables affiliates to refine execution strategies, improve content relevance, and optimize conversion outcomes. This capability-based approach is particularly important for mothers who must balance income generation with domestic responsibilities and therefore operate under time constraints.

At the platform and business level, improving system usability and support mechanisms is critical to enhancing affiliate effectiveness. Platforms that offer intuitive dashboards, structured tutorials, clear performance indicators, and responsive technical assistance can significantly lower operational barriers and improve execution quality. Simplifying workflows and making performance data more actionable allows affiliates with varying levels of digital experience to participate more effectively without increasing workload or cognitive burden.

At the industry and policy level, initiatives aimed at promoting digital entrepreneurship should prioritize skill development and platform readiness rather than participation alone. Training programs that combine practical digital capability building with direct exposure to platform tools are more likely to yield sustainable income outcomes than generic awareness initiatives. Collaboration among platform providers, educational institutions, and industry organizations can help ensure that training remains relevant to evolving platform dynamics. In the context of Indonesia's family-oriented economy, such capability-driven and ecosystem-based interventions can support inclusive, scalable, and sustainable digital livelihood opportunities.

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CHAPTER 7

A Case Study on the Role of Creative Design Process Activity Through Contents on Instagram and Customer's Satisfaction Towards Advocacy in KidZania Jakarta

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ABSTRACT

The rapid evolution of digital technology has transformed marketing landscapes, particularly for experience-based industries in Indonesia where Instagram serves as a primary touchpoint for customer engagement. Within the edutainment sector, KidZania Jakarta faces the challenge of understanding how the internal “creative design process activity” specifically influences customer satisfaction and the resulting electronic word-of-mouth (eWOM) advocacy. This study aims to explore the connection between internal creative intent and external customer behavior to optimize digital marketing effectiveness. The research employs a qualitative case study design focused on KidZania Jakarta’s digital presence, utilizing semi-structured in-depth interviews with both the internal marketing communication team and high-advocacy customers to capture a holistic view of the content lifecycle. Systematic thematic analysis is conducted via NVivo software to ensure academic rigor in decoding the relationship between creative workflows and consumer responses. The findings indicate that structured creative design activities significantly enhance the emotional resonance of visual content, which directly correlates with higher customer satisfaction levels. Analysis further demonstrates that thematic consistency and interactive design elements are the primary triggers that transition passive followers into active brand advocates. Ultimately, the results show that satisfaction acts as a mediator in the conversion of digital engagement into measurable advocacy. This study offers a key takeaway that a strategically audited creative process is essential for building brand loyalty, providing a practical framework for experience-based brands to strengthen their competitive advantage through content optimization.

Key Words: Creative Design, Instagram Marketing, Customer Advocacy, Edutainment, NVivo.

1. INTRODUCTION

With 212.9 million internet users in Indonesia, 143.9 million of whom are active on social media, the swift advancement of digital technology has drastically changed marketing environments. Instagram has emerged as a key engagement channel for experience-based enterprises. KidZania Jakarta needs to become an expert in its "creative process activity", the creative and strategic thinking that goes into its digital content, in order to transform passive followers into devoted brand ambassadors within the special edutainment industry. Leonard (2020) highlights that marketing communication must create meaningful, long-lasting relationships in order to sustain a competitive edge, while Tyran (1994) points out that successful communications happen when consumers receive consistent messaging across different touchpoints.

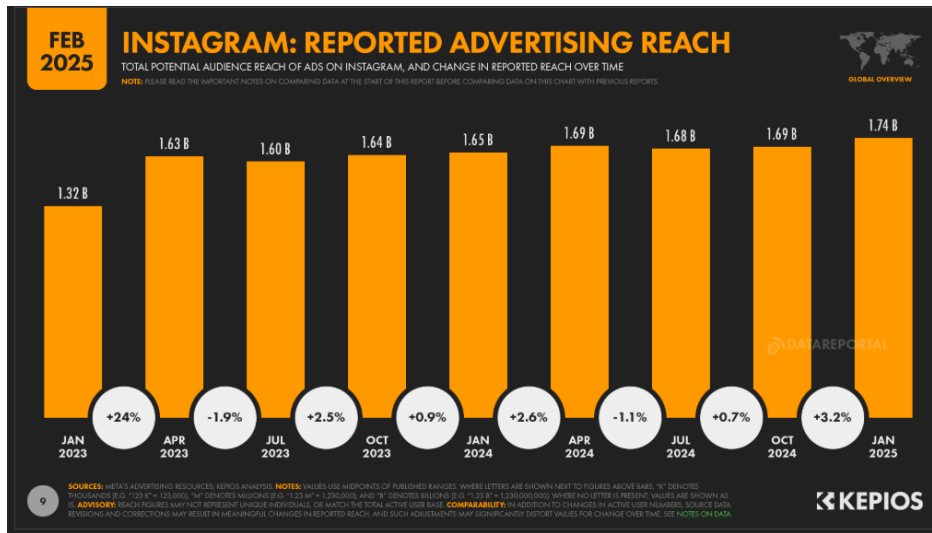


Figure 1 Instagram: Reported Advertising Reach

Figure 1 shows that there was a significant, smooth increment with the last two years, from 2023 for using Instagram as a social media advertising reach. This indicates that Instagram was a platform used until today which indicates an increase for the last Jan 2025. Therefore, Instagram as one of the platform for social marketing and media for exposure is still considerably a trend up to today.

1.2 Edutainment Sector – KidZania Jakarta Profile

KidZania Jakarta, established in 2007 at Pacific Place Mall, is a pioneer in the edutainment sector, offering an immersive indoor theme park experience. It features a child-sized replica city where children aged 2–16 can role-play over 100 professional careers in environments sponsored by real-world brands. By blending education with entertainment, the facility fosters essential life skills, including financial literacy, teamwork, and problem-solving, through interactive role-play using its own currency, 'kidZos'. To maintain relevance across a broader age range, the facility has expanded its offerings to include 'TeenZania,' a program specifically tailored to the developmental needs and digital habits of teenagers.

1.3 Problem Statement

Despite significant resource allocation toward Instagram marketing, a critical knowledge gap persists regarding how internal creative processes specifically influence customer satisfaction and electronic word-of-mouth (eWOM) advocacy. According to Grewal et al. (2021), it can be challenging for marketers to derive useful strategic recommendations from multimedia digital marketing data. KidZania Jakarta runs the

risk of misaligning its creative output with the varied demands of its target audience, which includes young children and teenagers, if it cannot understand this lifecycle.

1.4 Research Gap & Objectives

While previous studies have examined the role of creative content in educational settings (Altamira et al., 2023) and the relationship between e-service quality and loyalty (Leonnard, 2019), there is a lack of qualitative research tracing the path from the pre-content creative process to customer advocacy. This study aims to bridge this gap by exploring the creative-to-advocacy funnel to provide KidZania Jakarta with actionable strategic insights.

This study aims to examine the end-to-end influence of KidZania Jakarta's internal Creative Process Activity on Social Media Content, specifically analyzing how these creative inputs drive Customer Satisfaction and ultimately trigger Customer Advocacy behaviors among parents and teen audiences.

Therefore, the author considers on making a research based on case study to deep dive and understand the depth to enrich within the field of creativity and the advocacy from customer on how to create an engagement in a field of education and edutainment to understand the important factors that drove customer to consider their behavior.

2. LITERATURE REVIEW

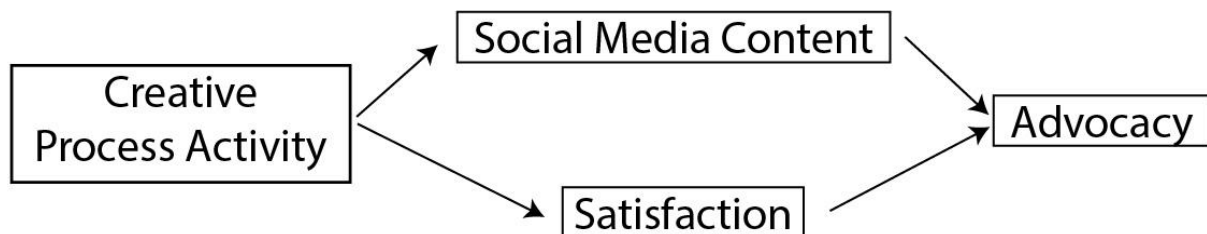


Figure 2 Conceptual Research Model Diagram

2.1 Theoretical Foundations

- **Creative Process:** According to Amabile (1996), creativity is the process of coming up with original and practical ideas, while design thinking offers the human-centered framework needed to hone these concepts into powerful marketing tools.
- **Social Media Content:** Instagram content marketing is rooted in digital and social media theories. By applying Communication Mix theory to digital channels, brands integrate online tools to meet marketing objectives. Instagram specifically serves as a platform for direct engagement, community building, and promotion. Furthermore, research underscores the strategic necessity of content marketing to achieve these communication goals (Nieves-Casasnovas & Lozada-Contreras, 2020).

- **Customer Satisfaction:** Drawing on the Expectancy-Disconfirmation Theory (Oliver, 1980), satisfaction is the evaluation of performance against expectations. In digital environments, e-service quality and trust are key drivers of this satisfaction (Leonnard, 2019).
- **Customer Advocacy:** The peak of relationship marketing is advocacy, where consumers willingly defend and support the brand (Leonnard & Susanti, 2019; Morgan & Hunt, 1994). The durability and reach of e-WOM enhance this behavior (Hennig-Thurau et al., 2004; Brown et al., 2005).

3. RESEARCH METHODOLOGY

This study employs a qualitative research methodology using a case study approach. This design is selected to explore and interpret the intricate mechanisms connecting the internal creative design process to external customer outcomes at KidZania Jakarta. A qualitative approach is essential for gathering rich, narrative data that explains the "how" and "why" of consumer motivation and organizational strategy, which cannot be captured through quantitative measurement.

3.1 Data Collection

To ensure research rigor, a multi-method approach was utilized:

- **In-depth Interviews:** Primary data were collected through semi-structured interviews with the marketing communication team and high-advocacy customers to capture diverse, first-hand perspectives.
- **Secondary Data:** Contextual data were gathered through documentary analysis, including organizational creative briefs, content calendars, and public Instagram performance metrics.
- **Observation:** The researcher conducted systematic observation of Instagram engagement, including post performance, audience comments, and public reviews, to validate interview findings.

3.2 Data Analysis (NVivo)

To ensure systematic rigor, all qualitative data were processed using NVivo software. The analysis followed the thematic analysis framework established by Braun and Clarke (2006):

- **Transcription and Familiarization:** Interview recordings were transcribed verbatim and imported into NVivo.
- **Coding:** A systematic process of initial open coding was performed, resulting in the creation of organized 'Nodes' that reflect the study's research objectives.
- **Theme Development:** Related nodes were synthesized into abstract, higher-level themes, which were mapped against the study's conceptual framework to validate the findings.

4. RESULT AND DISCUSSION

This chapter presents the findings of the study case from total of 6 respondents which the 2 are internal teams. This represent an outcome of the intensity of interview with the respondents to see on how Nvivo interprate the data after the strategic in-dpeth interview to deep dive the intention within each person that interviewed. To enrich the data and information, the author had condudted 3 models from Nvivo to represent the outcome:

4.1 Word Cloud

The Word Cloud served as an initial exploratory tool to identify the most frequently occurring terms across all interview transcripts. By visualizing the prominence of concepts such as "creative," "content,"

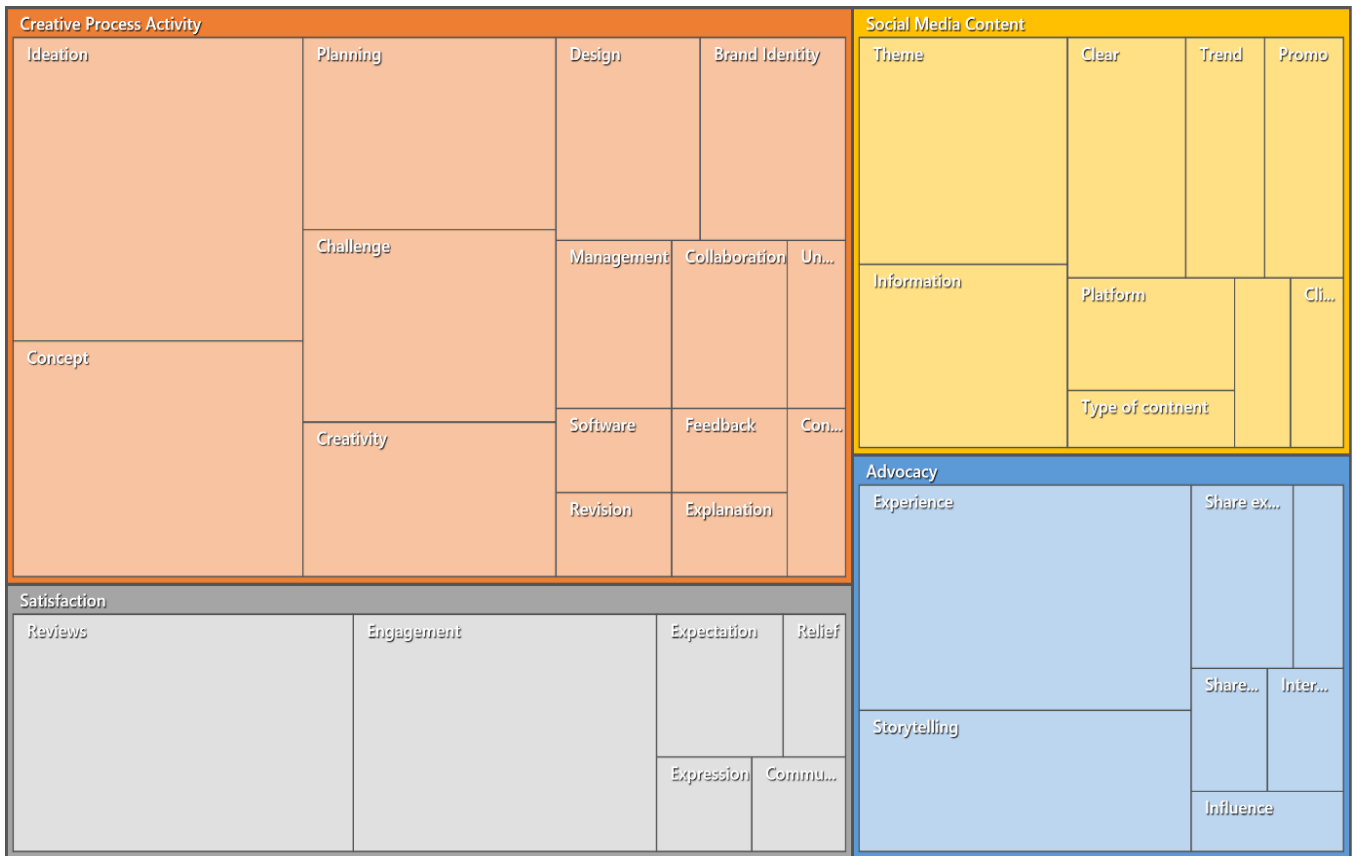


Figure 4 coded hierarchical chart from the interview

Figure 4 tells that the relation of what coded and the nodes association. As can be seen from the figure, “Creative Content Activity” seems to have the most coded theme in this thematic analysis. This “ideation” process can determine how the rest of the node affected. Significantly that creative process require the most consideration as there are more variables. In order to explain deeper, the author understand that ideation and brainstorming require proper, strategic thinking to tackle the context in the industry of edutainment.

4.3 Concept Map (Relational Mapping)

The Concept Map functioned as the definitive analytical integration tool, illustrating the pathways and connections between the four research variables. By mapping these relationships, the study demonstrates the logical progression—from the internal "Creative Process" to "Content" output, and ultimately to the consumer-side "Satisfaction" and "Advocacy". This visualization validates the theoretical model by grounding it in the empirical evidence gathered during the interview phase.

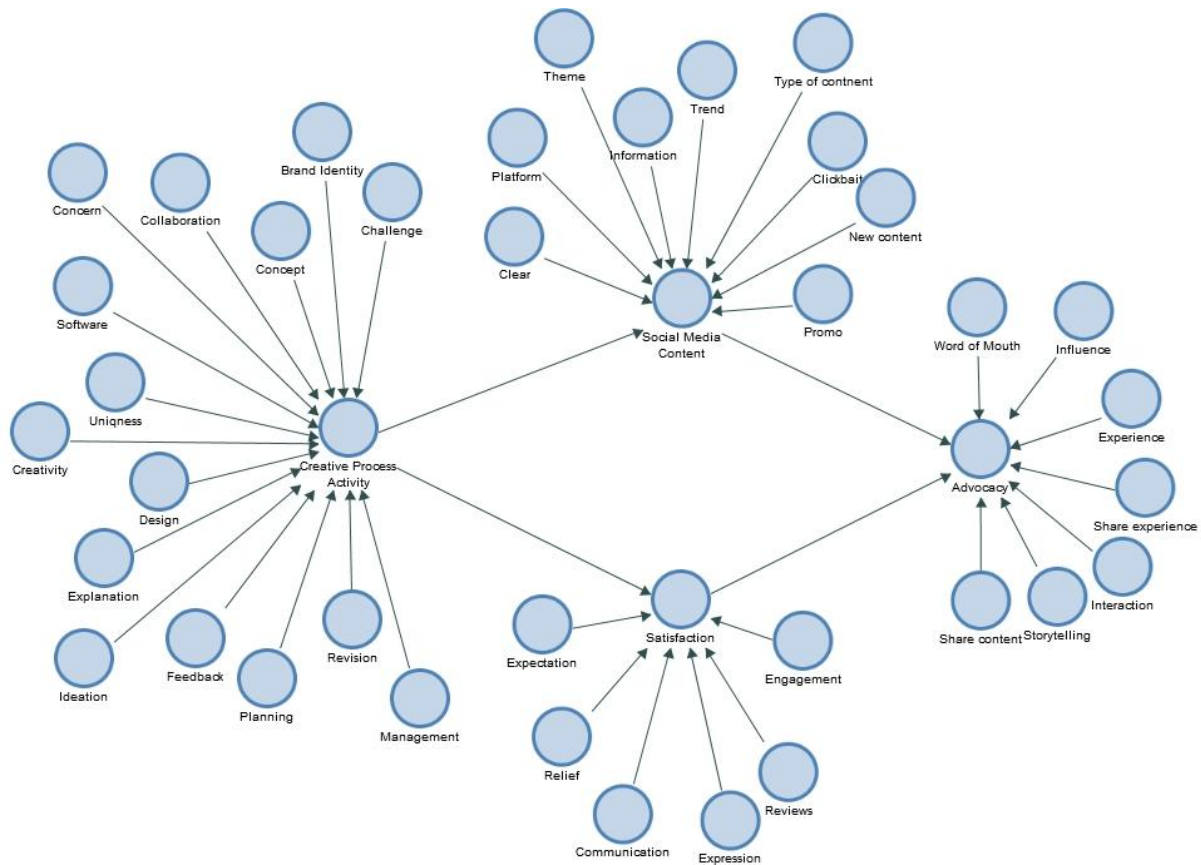


Figure 5 Concept map

As derived from the conceptual framework, the sub of the elements that drive people to advocate started to be clear that there are many variables to consider on further research. As can be seen on figure 5, the most variables come from Creative content activity. This means that in this phase, a step where making a content mih require many effort to have the right outcome that influneece other factor, such as social media contnetn, satisfaction and advocacy. Suctomer has the access to also review by giving feedback if the level of satisfaction they experience in social media does not match with the outcome that they experience. By understanding this pattern, the author conclude that there is a chain reacnion in between the code that affect each other respectively.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study has demonstrated that for experience-based brands like KidZania Jakarta, digital marketing effectiveness is not merely a result of content distribution, but a direct consequence of a structured Creative Process Activity. Our findings confirm that when internal creative workflows are aligned with the emotional expectations of the target audience, the resulting Instagram content significantly enhances Customer Satisfaction. Furthermore, we identified that satisfaction serves as a critical mediator in the conversion of passive social media followers into active Customer Advocacy. By bridging the gap between internal creative intent and external consumer behavior, this research provides a clear roadmap for edutainment brands to strengthen their competitive advantage through content optimization.

5.2 Managerial Implications

Based on these findings, we propose the following strategic recommendations for KidZania Jakarta:

- **Formalize the Creative-Content Loop:** The marketing team should implement a standardized audit of the creative design process to ensure that visual elements consistently align with the brand's emotional narrative.
- **Prioritize Narrative-Driven Content:** As storytelling was identified as a primary trigger for advocacy, the team should shift focus from purely promotional posts to content that highlights personal experiences, family milestones, and educational journeys within the theme park.
- **Segmented Engagement Strategies:** Given the diverse demographic ranging from parents to "TeenZania" users, content should be curated specifically for these distinct segments, utilizing interactive design elements that resonate with their respective age groups.

5.3 Limitations and Future Research

While this study provides deep qualitative insights into the KidZania Jakarta case, future research could expand this scope by:

- **Longitudinal Analysis:** Tracking how creative process changes impact advocacy metrics over a longer multi-year period.
- **Cross-Industry Application:** Investigating whether these findings hold true for other experience-based industries, such as hospitality or destination travel.

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CHAPTER 8

The Impact of Digitalization Strategy Adoption and Digital Transformation on Sustainable Business Performance: The Roles of Market Driven Business Model Innovation and Digital Leadership Capabilities in Indonesia

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ABSTRACT

This study examines the impact of digitalization strategy adoption and digital transformation on sustainable business performance, emphasizing the mediating role of market-driven business model innovation and the moderating role of digital leadership capabilities within Indonesian companies. In the context of increasing technological disruption and sustainability pressures, firms are required not only to adopt digital technologies but also to strategically integrate them into their business models to achieve long-term performance outcomes. Drawing on Dynamic Capabilities Theory, this study presents a moderated mediation model. It posits that the adoption of digitalization strategies and digital transformation initiatives impact sustainable business performance via market-driven business model innovation. Furthermore, digital leadership capabilities are suggested to amplify the connection between business model innovation and sustainable performance. The research utilizes a quantitative methodology, gathering primary data through questionnaires administered to mid- to senior level managers from publicly listed companies (Tbk) and state-owned enterprises (BUMN) within Indonesia. Partial Least Squares Structural Equation Modeling (PLS-SEM) is employed to analyze the data, thereby assessing direct, mediating, and moderating effects. The anticipated results are that a digitalization strategy, coupled with digital transformation, will significantly improve sustainable business performance, contingent upon the implementation of innovative, market-oriented business models and robust digital leadership capabilities. This research expands upon existing scholarship by applying Dynamic Capabilities Theory to the domains of digitalization and sustainability within emerging markets. From a practical standpoint, it offers strategic guidance to Indonesian companies aiming to integrate digital endeavors with enduring, sustainable business outcomes.

Keywords: Digitalization Strategy, Digital Transformation, Business Model Innovation, Digital Leadership, Sustainable Business Performance, Indonesia

INTRODUCTION

Indonesia has established itself as the largest digital economy in Southeast Asia, driven by high internet penetration, a large young demographic, and sustained investment in digital infrastructure. Its digital economy grew from approximately USD 27 billion in 2017 to an estimated USD 130 billion by 2025, contributing an increasing share of national GDP (ERIA, 2023). Digital transformation has accordingly become a strategic priority across sectors, including among state-owned enterprises (BUMN) and publicly listed companies (Tbk), which together represent the backbone of Indonesia's formal economy.

Despite this momentum, digital investment does not automatically generate sustainable business performance. In practice, many digital initiatives lead to incremental operational improvements, greater efficiency, lower costs, faster processes, without producing lasting competitive advantages or meaningful economic, environmental, and social outcomes (Verhoef et al., 2021; Vial, 2019). This gap is especially pronounced in Indonesia, where sector-level digital maturity remains uneven, with e-commerce dominating digital value creation while sectors such as manufacturing, healthcare, and public services lag significantly behind (Statista, 2022).

The literature identifies two distinct but interdependent aspects of corporate digitalization. Digitalization Strategy Adoption (DSA) refers to the formal, strategic commitment to integrating digital technologies into corporate direction and resource allocation (Bharadwaj et al., 2013). Digital Transformation (DT) refers to the operational and organizational change process by which digital technologies are embedded across business processes, capabilities, and value creation mechanisms (Vial, 2019). Prior research has tended to treat these constructs in isolation, overlooking how their combined effect operates through business model change.

A critical mechanism that explains the gap between digital investment and performance is Market-Driven Business Model Innovation (MDBMI): the reconfiguration of value proposition, value creation, and value capture in response to evolving market demands (Foss & Saebi, 2017; Clauss, 2017). Without such reconfiguration, digital technology remains a means rather than a source of competitive advantage. Furthermore, the extent to which digital and innovation capabilities translate into sustainable performance depends substantially on Digital Leadership Capabilities (DLC), the managerial and behavioral competencies that guide organizations through transformation (Kane et al., 2019).

This paper therefore proposes an integrated moderated mediation framework and six research hypotheses to examine how DSA and DT influence SBP through MDBMI, with DLC as a moderating factor. The study targets Indonesian publicly listed companies and BUMN as its empirical context, contributing both theoretically by extending Dynamic Capabilities Theory into the digital sustainability domain in an emerging market and practically, by offering a structured decision framework for Indonesian executives managing digital transformation.

1. LITERATURE REVIEW

1.1 Digital Transformation

Digital Transformation (DT) is the deep, continuous process by which organizations leverage advanced digital technologies, including artificial intelligence, cloud computing, big data analytics, and automation to fundamentally redesign processes, reshape customer engagement, and reconfigure value creation (Vial,

2019; Verhoef et al., 2021). Unlike DSA, which operates at the strategic planning level, DT is the execution and implementation dimension of digital change.

Within Dynamic Capabilities Theory, DT embodies the "transforming" capability, the reconfiguration of internal processes and competencies to respond to environmental change (Teece, 2007). Empirical research consistently finds that DT enhances organizational agility, operational efficiency, and innovation capacity (Warner & Wäger, 2019; Chen et al., 2024). However, DT does not by itself guarantee performance improvement: the transformation process must be channeled into business model change to produce sustainable value.

Table 1. Comparison between Digitalization Strategy Adoption and Digital Transformation

Dimension	DSA	DT
Scope	Strategic integration of digital into corporate planning	Organization-wide transformation of processes, models, and culture
Focus	Strategic enablement and resource alignment	Execution and operational reconfiguration
Level	Strategic (planning and direction-setting)	Operational and organizational (implementation)
Timeframe	Short-to-medium-term planning horizon	Long-term, continuous process
Goal	Competitive positioning and strategic alignment	Innovation, agility, and sustained competitive advantage

Source: Developed by the Author (2026)

1.2 Market Driven Business Model Innovation

Market-Driven Business Model Innovation (MDBMI) refers to the systematic redesign of how a firm creates, delivers, and captures value in response to shifting market demands, stakeholder expectations, and competitive dynamics (Foss & Saebi, 2017; Clauss, 2017). It is market-driven in that it is guided by external signals like customer feedback, competitor behavior, emerging sustainability demands, rather than purely internal technology considerations.

Within the Dynamic Capabilities framework, MDBMI operationalizes the "transforming" dimension at the business model level: after sensing and seizing digital opportunities, firms must reconfigure their value systems to sustain competitive advantage (Teece, 2007). Empirical research supports MDBMI as the critical mechanism linking digital capabilities to performance outcomes, including sustainability (Chen et al., 2024; Warner & Wäger, 2019; Böttcher et al., 2024). This study positions MDBMI as the mediating variable in the proposed framework.

1.3 Digital Leadership Capabilities

Digital Leadership Capabilities (DLC) encompass the managerial and behavioral competencies that enable leaders to guide organizations through digital transformation and innovation, including strategic vision articulation, digital governance, cultural stewardship, and the facilitation of cross-functional collaboration (Kane et al., 2019; Hess et al., 2016). Leadership in digital contexts extends beyond technical knowledge; it is fundamentally about mobilizing organizational resources and fostering the conditions under which

innovation can be institutionalized.

Dynamic Capabilities Theory recognizes leadership as a critical micro foundation: managerial capabilities shape whether and how effectively firms sense, seize, and transform opportunities (Teece, 2007). Organizations with strong digital leadership are significantly more likely to translate digital investments into measurable performance outcomes (Westerman et al., 2014; Chen et al., 2024). DLC is positioned in this study as a moderating variable strengthening the MDBMI → SBP relationship.

1.4 Sustainable Business Performance

Sustainable Business Performance (SBP) refers to an organization's ability to generate long-term value across economic, environmental, and social dimensions, as conceptualized in the Triple Bottom Line framework (Elkington, 1997). SBP moves beyond traditional financial metrics to include environmental stewardship and social responsibility like employee wellbeing, stakeholder engagement, and community impact.

Within Dynamic Capabilities Theory, SBP represents the outcome of a firm's sustained ability to reconfigure resources in response to environmental change (Teece, 2007). Digital initiatives can contribute to all three SBP dimensions: economically through productivity and new revenue streams; environmentally through real-time monitoring and predictive maintenance; and socially through improved transparency and stakeholder communication. SBP is the dependent variable in this study.

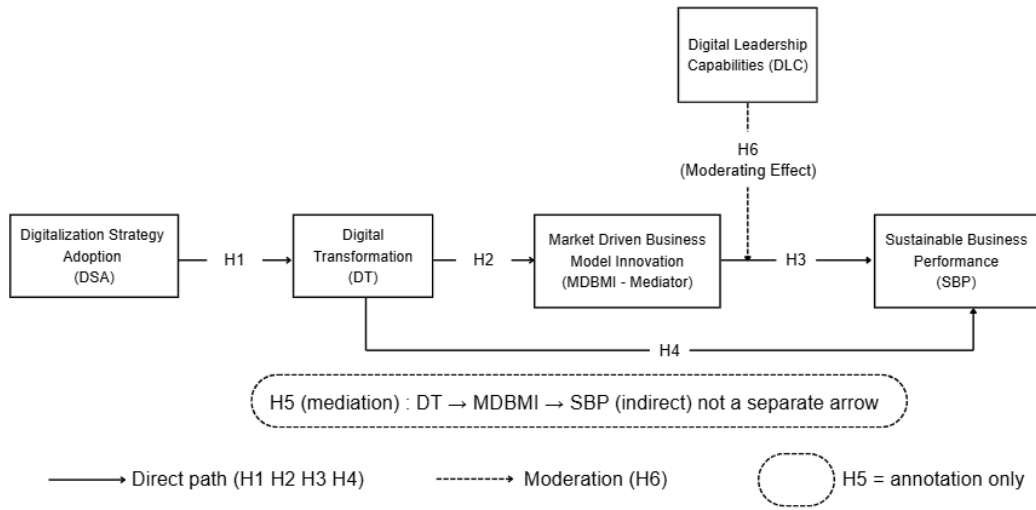
1.5 Dynamic Capabilities Theory as Theoretical Foundation

Dynamic Capabilities Theory (DCT), originally proposed by Teece, Pisano, and Shuen (1997) and extended by Teece (2007), explains how firms develop and sustain competitive advantage in volatile, technology driven environments. Unlike the Resource-Based View, which emphasizes static resource ownership, DCT centers on the capacity to integrate, build, and reconfigure internal and external competencies in response to change. The three core dimensions: sensing, seizing, and transforming provide theoretical scaffolding for this study's research model: DSA maps to seizing, DT to transforming, MDBMI to the transforming outcome, DLC to the managerial micro foundation, and SBP to the sustained performance result.

2. CONCEPTUAL FRAMEWORK AND PROPOSITIONS

This study proposes a moderated mediation model in which DSA and DT (independent variables) influence SBP (dependent variable) through MDBMI (mediator), with DLC acting as a moderator of the MDBMI to SBP relationship. The framework is grounded in Dynamic Capabilities Theory and explains not only whether digital initiatives improve sustainable performance, but through what mechanism and under what leadership conditions.

Figure 1. Conceptual Framework



Source: Developed by the Author (2026)

The hypotheses are developed as follows:

H1: Digitalization Strategy Adoption positively influences Market-Driven Business Model Innovation. A clearly articulated digital strategy provides the structural and cognitive conditions for business model experimentation. Firms with strong digital strategic orientation are better equipped to redesign value propositions and respond to market dynamics (Bharadwaj et al., 2013; Chen et al., 2024; Warner & Wäger, 2019).

H2: Digital Transformation positively influences Market-Driven Business Model Innovation. Digital transformation equips organizations with enhanced data capabilities, operational flexibility, and digital platforms that enable innovative value configurations. Organizations that successfully implement digital change are better positioned to develop market-responsive business models (Vial, 2019; Chen et al., 2024).

H3: Market-Driven Business Model Innovation positively influences Sustainable Business Performance. Business model innovation that aligns digital capabilities with evolving market and stakeholder expectations enables firms to improve economic, environmental, and social performance simultaneously (Elkington, 1997; Clauss, 2017; Chen et al., 2024).

H4: Market-Driven Business Model Innovation mediates the relationship between Digitalization Strategy Adoption and Sustainable Business Performance. The impact of DSA on SBP is not direct but is channeled through business model reconfiguration. Digital strategy creates the preconditions for innovation; it is the innovation itself that generates sustainable value (Warner & Wäger, 2019; Chen et al., 2024).

H5: Market-Driven Business Model Innovation mediates the relationship between Digital Transformation and Sustainable Business Performance. Technology implementation alone does not produce sustainable outcomes without corresponding changes in how value is created and delivered to the market (Vial, 2019; Böttcher et al., 2024).

H6: Digital Leadership Capabilities positively moderate the relationship between Market-Driven Business Model Innovation and Sustainable Business Performance, such that this relationship is stronger when Digital Leadership Capabilities are high. Strong leadership ensures that innovative business models are successfully implemented, scaled, and embedded in organizational systems (Kane et al., 2019; Chen et al., 2024).

Table 2. Research Variables, Roles, and Theoretical Foundations

Variable	Role	Core Concept	DCT Dimension
DSA	Independent	Strategic digital alignment	Seizing
DT	Independent	Operational transformation	Transforming
MDBMI	Mediator	Business model reconfiguration	Transforming outcome
DLC	Moderator	Managerial leadership	Microfoundation
SBP	Dependent	Triple Bottom Line performance	Sustained outcome

Source: Developed by the Author (2026)

3. EXPECTED RESULTS & DISCUSSION

As this paper presents a proposed empirical study, no data have yet been collected. The following discussion addresses theoretical expectations based on the conceptual framework and prior literature, and their implications for the Indonesian context.

DSA and DT as antecedents of MDBMI (H1, H2). Both digitalization strategy adoption and digital transformation are expected to positively and significantly influence MDBMI. DSA provides the strategic architecture to clarity of direction, resource commitment, cross-functional governance that enables firms to identify and pursue business model innovation opportunities. DT supplies the operational infrastructure and data capabilities that make such innovation executable. In the Indonesian context, BUMN firms that have formalized digital roadmaps but show widely varying outcomes illustrate that the pathway through MDBMI is the critical differentiating variable.

MDBMI as mediator of digital initiatives and SBP (H3, H4, H5). The central proposition is that MDBMI is the mechanism through which digital investments become sustainable performance outcomes. Digital strategy and digital transformation, without accompanying business model reconfiguration, are expected to produce at best incremental improvements in operational efficiency not the economic resilience, environmental responsibility, and social equity that define SBP. Firms that have moved beyond operational digitalization toward new platform-based service models, digital-enabled ecosystem partnerships, or data-driven sustainability reporting are better positioned to capture Triple Bottom Line value (Chen et al., 2024; Böttcher et al., 2024).

DLC as moderator of MDBMI → SBP (H6). Digital leadership is expected to amplify the performance impact of business model innovation. High-DLC leaders ensure that innovative business models are properly resourced, scaled, and institutionalized. In Indonesia's BUMN context specifically, where organizational

inertia, bureaucratic governance, and multiple stakeholder pressures are common, leadership capability is likely to be a particularly decisive moderator. Kane et al. (2019) finds that digital maturity depends more on leadership mindset than technology investment, a finding expected to be replicated and extended in this study.

Implications for Indonesian firms. For publicly listed companies and BUMN, the expected findings carry a clear practical message: digital investment alone is neither necessary nor sufficient for sustainable performance. Firms should invest simultaneously in (a) formalizing digital strategy, (b) executing cross-functional digital transformation, (c) redesigning business models in response to market signals, and (d) developing the leadership capabilities needed to govern innovation on a scale. The moderated mediation framework provides a structured roadmap for this integrated approach.

CONCLUSION

This paper proposes an integrated moderated mediation framework to examine how Digitalization Strategy Adoption and Digital Transformation influence Sustainable Business Performance, mediated by Market-Driven Business Model Innovation and moderated by Digital Leadership Capabilities. The framework is grounded in Dynamic Capabilities Theory and contextually situated within Indonesian publicly listed companies and state-owned enterprises.

The central theoretical contribution is the explicit articulation of the pathway from digital investment to sustainable performance: digital initiatives must be translated into innovative, market-responsive business models, and this translation is strengthened by strong digital leadership. This extends Dynamic Capabilities Theory into the intersection of digitalization and sustainability in an emerging market, where integrated empirical evidence remains limited.

From a practical standpoint, the framework offers Indonesian executives a structured approach to moving beyond fragmented digital projects toward capability-driven, innovation-grounded, and leadership-enabled transformation. For BUMN and publicly listed companies facing increasing pressure from sustainability reporting requirements, ESG-conscious investors, and regulatory mandates, the ability to connect digital strategy with sustainable business outcomes is increasingly a governance imperative.

Future research should focus on empirical validation through PLS-SEM data collection, sector-level moderator analysis (e.g., regulated vs. competitive industries), longitudinal study designs to capture transformation trajectories, and cross-country comparative studies within ASEAN to enrich generalizability.

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CHAPTER 9

The Effect of Product Difference, Customer Experience, and Brand Image on the Decision to Choose Tazkirunnas Madrasah Ibtidaiyah

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ABSTRACT

This study aims to analyze the influence of product differentiation, customer experience, and brand image on parents' decisions in selecting a school at Madrasah Ibtidaiyah Tazkirunnas. The research background is based on the phenomenon of fluctuations in student enrollment and sub-optimal utilization of school capacity, indicating challenges in educational service marketing. The research employs a quantitative approach using a survey method. The population consists of all parents/guardians of students at MI Tazkirunnas for the 2025–2026 academic year (N = 214), with a sample of 140 respondents. Data were collected through validated and reliable questionnaires and analyzed using path analysis (SPSS v.25). The results indicate that: (1) product differentiation has a positive and significant effect on brand image ($\beta = 0.117$); (2) customer experience has the largest effect on brand image ($\beta = 0.831$); (3) product differentiation positively influences school selection decisions ($\beta = 0.068$); (4) customer experience positively influences school selection decisions ($\beta = 0.084$); and (5) brand image is the most dominant factor influencing school selection decisions ($\beta = 0.853$). The model explains 95.6% of variance in school selection decisions. These findings highlight the critical importance of strengthening unique educational programs, improving service quality, and building a positive and credible madrasah brand image.

Keywords: Product Differentiation, Customer Experience, Brand Image, School Selection Decision, Islamic Elementary School, Path Analysis.

INTRODUCTION

Background

Madrasah Ibtidaiyah Tazkirunnas was established on 17 July 2017 under the auspices of Yayasan Tazkirunnas Ilal Akhirah — Habib Umar Bin Hoed Al Athas. Located at Jl. Batu Ampar I No. 45 Condet, Kramatjati, East Jakarta, the school operates as an Islamic elementary school with a pesantren (boarding school) atmosphere, currently holding an 'A' Accreditation (Operating Permit No. 454/2018, NSM 111231750122, NPSN 69982752). Its tagline is 'An Islamic School Based on Al-Qur'an and As-Sunnah with a Pesantren Atmosphere.'

Since its founding, the school has faced challenges in achieving its target student enrollment relative to available capacity. With a total capacity of 264 students (2 gender-separated classes of 22 students across 6 grade levels), the 2025–2026 academic year shows a total enrollment of only 214 students (80.06% capacity utilization), with a shortfall of 50 students. Tables 1.1 and 1.2 below present the detailed enrollment and new student admission data.

Table 1 Student Enrollment Data, MI Tazkirunnas Academic Year 2025–2026

No	Grade	Male	Female	Total	Capacity	Shortage
1	Grade 1	20	22	42	44	-2
2	Grade 2	14	14	28	44	-16
3	Grade 3	20	22	42	44	-2
4	Grade 4	20	13	33	44	-11
5	Grade 5	13	11	24	44	-20
6	Grade 6	22	23	45	44	+1
	TOTAL	109	105	214	264	-50

Table 2 New Student Admissions (PPDB), MI Tazkirunnas 2021–2026

No.	Academic Year	Male	Female	Total
1	2021/2022	14	6	20
2	2022/2023	22	14	36
3	2023/2024	24	23	47
4	2024/2025	14	15	29
5	2025/2026	20	22	42
	TOTAL	94	80	174

The new student admission data reveals significant annual fluctuations (from 20 in 2021/2022 to a peak of 47 in 2023/2024, then declining to 29 in 2024/2025 before recovering to 42 in 2025/2026), indicating inconsistency in demand attraction. These phenomena motivate a rigorous empirical investigation into the factors driving parental school selection decisions, particularly product differentiation, customer experience, and brand image.

Based on preliminary interviews conducted by the school's admissions committee, most prospective parents consider: (1) the school's unique educational programs (product differentiation) combining general knowledge with strong Islamic values; (2) their experiential interactions with the school's administration,

teachers, and religious community network; and (3) the school's reputation and brand image linked to the personal figure of Habib Umar Bin Hoed Al Athas. However, no prior empirical study has simultaneously examined all three factors in this Islamic elementary school context.

Problem Identification

The core problem is the fluctuating enrollment and under-utilized capacity at MI Tazkirunnas amid intense competition from other private elementary schools. Specific issues include: the extent to which product differentiation creates competitive advantage for school selection; how the quality of customer experience shapes parental perceptions and decisions; and whether brand image serves as the dominant factor in school selection. Contextual factors excluded from this study (tuition fees, school location/accessibility, and digital promotion) are acknowledged but not the focus of this research.

Research Objectives

This study aims to analyze and provide empirical evidence of: (1) the effect of product differentiation on brand image; (2) the effect of customer experience on brand image; (3) the direct effect of product differentiation on school selection decisions; (4) the direct effect of customer experience on school selection decisions; and (5) the direct effect of brand image on school selection decisions at MI Tazkirunnas.

THEORETICAL FRAMEWORK, CONCEPTUAL FRAMEWORK & HYPOTHESES

Variable Definitions

Product Differentiation refers to the strategy of offering educational programs and services that are unique and superior compared to competitors, covering curriculum design, teaching methodology, facilities, extracurricular activities, and value-added services. In the context of MI Tazkirunnas, this includes the Kurikulum Merdeka integrated with Islamic character formation, Cambridge English and Arab Saudi Arabic language programs, Tahfidz Al-Quran (3 juz), and a pesantren-style daily routine (Aaker, 2018; Porter, 2019).

Customer Experience refers to the totality of perceptions and feelings experienced by parents and students in all interactions with the school — from information search, administrative service, teacher-parent communication, and open house participation, to ongoing educational experiences and involvement in the Habib Umar religious community (Jamaah Majelis). Positive experiences create satisfaction and loyalty; negative experiences reduce the probability of school selection (Schmitt, 2020; Pine & Gilmore, 2019).

Brand Image refers to the set of perceptions, beliefs, and associations held by parents and the public toward MI Tazkirunnas, shaped by the reputation of Habib Umar Bin Hoed Al Athas as a positive religious figure, the school's institutional accreditation, quality of graduates, and consistent religious atmosphere. A positive brand image generates credibility and trust that directly influences school selection (Keller, 2020; Firmansyah, 2018).

School Selection Decision refers to the process by which parents choose MI Tazkirunnas for their children's education, involving awareness of the school, information gathering, evaluation of alternatives, and the final enrollment decision. This decision is shaped by rational and emotional considerations and reflects parents' trust and confidence in the school's ability to fulfill their educational expectations (Kotler & Keller, 2020).

Prior Research

Table 3 Summary of Prior Research

Author (Year)	Variables	Key Finding
Aditya (2022)	Customer Experience & Brand Image → Repurchase Intention	CE moderated by BI has non-significant negative effect on repurchase intention
Fadlilah (2025)	Product Differentiation & Brand Image → Purchase Decision	PD and social media marketing have positive significant effect on Brand Image
Pewartar (2022)	Product Differentiation & Social Media Marketing → Purchase Decision	PD has positive significant effect; some paths non-significant
Sueni (2024)	Customer Experience & Brand Image → Repurchase Decision	Brand Image has positive significant effect on repurchase decision
Sarini (2023)	Brand Image & Service Satisfaction → School Selection Decision	Brand Image and service satisfaction both significantly influence school selection
Sya'idah (2024)	Brand Image → School Selection Decision	Brand Image has significant impact on school selection decision
Rachmawati (2025)	Product Differentiation & Price Perception → Purchase Decision	Product differentiation significantly influences purchase decision
Wahyudi (2025)	Digital Marketing & Customer Experience → School Selection Decision	Customer Experience significantly influences parental school selection
Fadhilah (2025)	Brand Image & Service Quality → School Selection Decision	Brand Image positively and significantly influences parents' decisions
Alamsyah (2023)	Brand Image, Digital Marketing & Reference Group → School Selection	Digital marketing and reference group significant; Brand Image not significant

Conceptual Framework

The conceptual framework is grounded in the theoretical relationships among the four variables. Product differentiation builds brand identity and competitive positioning (Aaker, 2018; Tjiptono, 2019). Customer experience creates emotional bonds and positive associations that strengthen brand image (Keller, 2020; Chen & Lin, 2021). Brand image, in turn, acts as the primary driver of school selection decisions by representing quality, reliability, and trustworthiness to parents (Ahmed et al., 2019). The model proposes that X1 and X2 directly influence both X3 (brand image) and Y (school selection), with X3 also directly influencing Y.

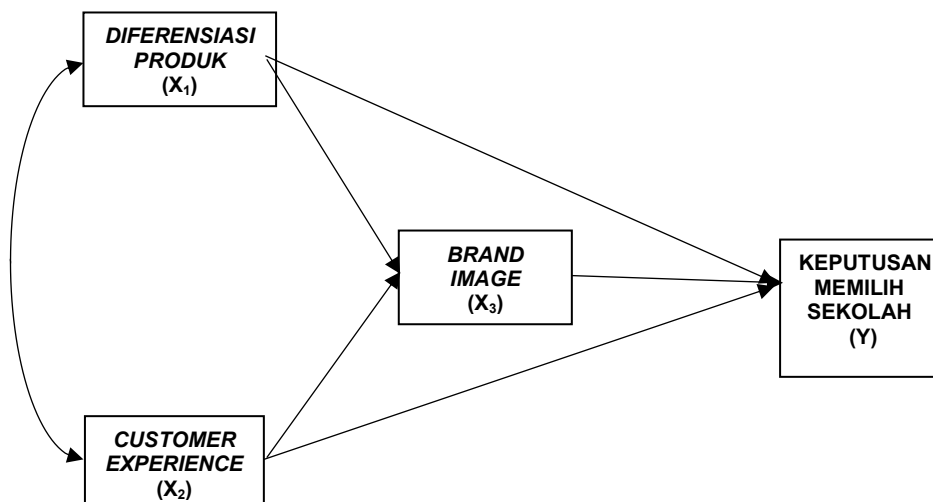


Figure 1 Research Conceptual Framework

D. Hypotheses

1. H1: Product differentiation has a direct positive and significant effect on Brand Image at MI Tazkirunnas.
2. H2: Customer experience has a direct positive and significant effect on Brand Image at MI Tazkirunnas.
3. H3: Product differentiation has a direct positive and significant effect on School Selection Decision at MI Tazkirunnas.
4. H4: Customer experience has a direct positive and significant effect on School Selection Decision at MI Tazkirunnas.
5. H5: Brand image has a direct positive and significant effect on School Selection Decision at MI Tazkirunnas.

RESEARCH METHODOLOGY

Research Design, Location & Timeline

This study employs a quantitative approach with a causal-correlational survey design. The research was conducted at Madrasah Ibtidaiyah Tazkirunnas, Jl. Batu Ampar I No. 45 Condet, Kramatjati, East Jakarta, with data collection conducted in December 2025.

Population, Sample & Sampling Technique

The research population consists of all parents/guardians of students at MI Tazkirunnas for academic year 2025–2026 (N = 214). Using the Slovin formula at a 5% margin of error: $n = 214 / (214 \times 0.05^2 + 1) \approx 140$ respondents. Simple random sampling was applied, with questionnaires distributed directly through class teachers (homeroom coordinators) to maximize response rate. All 140 questionnaires were returned complete and valid.

Research Instrument

Data were collected via a structured questionnaire using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). All instruments were pre-tested for validity (Pearson product-moment correlation, $r > 0.195$ at $\alpha = 0.05$) and reliability (Cronbach's $\alpha > 0.70$). The instrument structure is summarized below:

Table 4 Research Instrument Summary

Variable	Role	Key Dimensions / Indicators	Items	Scale
School Selection Decision (Y)	Endogen	Choice awareness; Information search; Evaluation of alternatives; Final decision; Post-decision evaluation	20	1–5 Likert
Product Differentiation (X1)	Exogen	Curriculum uniqueness; Islamic values integration; Language programs (English/Arabic); Extracurricular; Facilities	20	1–5 Likert
Customer Experience (X2)	Exogen	Administrative service; Teacher–parent communication; Learning process quality; School environment; Religious community engagement	20	1–5 Likert
Brand Image (X3)	Exogen	Institutional reputation; Quality of graduates; Religious atmosphere; Accreditation; Community trust	20	1–5 Likert

Data Analysis Method

Data were processed using SPSS v.25 through the following sequence. Classical assumption tests: (1) Normality — Kolmogorov-Smirnov test (sig. > 0.05); (2) Linearity ANOVA deviation-from-linearity (F-calc. < F-table or sig. > 0.05); (3) Homogeneity of Variance Levene's test (sig. > 0.05). Path Analysis (Analisis Jalur): Two substructures were tested — Substructure 1 (X1, X2 → X3) and Substructure 2 (X1, X2, X3 → Y) producing standardized path coefficients (β), t-statistics, and model fit statistics (R^2). Hypothesis testing used one-tailed criteria: t-calc. > t-table (1.992) and Sig. < 0.05.

RESULTS AND DISCUSSION

Overview of Research Object

Madrasah Ibtidaiyah Tazkirunnas operates as an Islamic primary school with a strong pesantren identity. The school's distinctive features include: (1) Kurikulum Merdeka (Freedom Curriculum) integrated with character formation based on Al-Qur'an and As-Sunnah; (2) Cambridge English and Arab Saudi Arabic language enrichment programs; (3) Tahfidz Al-Quran 3 Juz program; (4) daily pembiasaan (habituation) activities including Muroja'ah, Asmaul Husna, Ratib Al-'Athas, and Maulid Addiba'i; (5) annual events including Mabit (pesantren retreat at Huraidhoh Bogor), Pesantren Kilat, Study Tour, Tahun Baru Islam Parade, and Maulid Nabi celebration; and (6) a strong community network through the Jamaah Majelis of Habib Umar Bin Hoed Al Athas, which provides a unique intangible asset for the school's brand image.

The school's organizational structure includes the Principal, Administrative Division, Academic Division, and Student Affairs Division. The research population (N = 214) represents all active parents/guardians, with a sample of 140 respondents ranging from lower-middle to middle-upper socioeconomic backgrounds, with mothers playing the dominant role in school selection decisions.

Descriptive Statistics

Descriptive statistics for all four research variables (n = 140) are summarized in Table 4.1 below. All variables show approximately symmetric distributions (skewness near zero) with slight platykurtic tendencies (kurtosis ≈ -0.93), indicating adequate score spread across the Likert scale range. Mean scores for all variables are approximately 59–62, reflecting moderate-to-positive perceptions across the sample.

Table 5 Descriptive Statistics Summary of Research Variables

Statistic	School Selection (Y)	Product Differentiation (X1)	Customer Experience (X2)	Brand Image (X3)
N Valid	140	140	140	140
Mean	59.15	61.78	60.84	61.31
Median	60.50	61.00	61.50	61.00
Mode	34	70	57	74
Std. Deviation	19.024	17.925	18.888	19.055
Variance	361.913	321.310	356.757	363.106
Skewness	-0.017	-0.020	-0.027	0.021
Kurtosis	-0.932	-0.971	-0.922	-0.933
Minimum	22	24	24	25
Maximum	99	98	100	100

The histograms for all four variables confirm near-normal distributions, supporting the validity of parametric path analysis. Brand image (X3) and customer experience (X2) show the widest ranges (min 25, max 100), indicating high variability in perceptions an important finding suggesting heterogeneous parental experiences with the school.

Classical Assumption Tests

Normality Test (Kolmogorov-Smirnov)

Table 6 Normality Test Results (One-Sample Kolmogorov-Smirnov)

Variable	Sig. Level (α)	K-S Sig. Value	Result
Product Differentiation (X1)	0.05	0.051	Normal
Customer Experience (X2)	0.05	0.086	Normal
Brand Image (X3)	0.05	0.200	Normal
School Selection Decision (Y)	0.05	0.062	Normal

All four variables pass the normality test (K-S Sig. > 0.05), confirming that residuals follow a normal distribution and validating the use of parametric path analysis.

Linearity Test

Table 7 Linearity Test Results (ANOVA Deviation from Linearity)

Variable Pair	F-table	F-calc (Dev. Linearity)	Sig.	Result
X1 – X3 (BI)	3.960	1.073	0.382	Linear
X2 – X3 (BI)	3.960	0.575	0.987	Linear
X1 – Y	3.960	1.266	0.163	Linear
X2 – Y	3.960	0.504	0.997	Linear
X3 – Y	3.960	1.001	0.492	Linear

All variable pairs exhibit linear relationships (F-calc. < F-table = 3.960; Sig. > 0.05), confirming that the assumed linear relationships in the path model are appropriate.

Homogeneity of Variance Test (Levene's Test)

Table 8 Homogeneity of Variance Test Results

Variable Pair	Levene Sig. (α)	Levene Sig. Calc.	Result
X1 – X3	0.05	0.480	Homogeneous
X2 – X3	0.05	0.931	Homogeneous
X1 – Y	0.05	0.119	Homogeneous
X2 – Y	0.05	0.430	Homogeneous
X3 – Y	0.05	0.354	Homogeneous

All variable pairs show homogeneous variances (Levene's Sig. > 0.05), satisfying the final prerequisite for path analysis. All three classical assumptions are met, confirming the validity and robustness of the analytical approach.

Path Analysis Results

Substructure 1: X1, X2 → X3 (Brand Image)

Table 9 Path Coefficients: Substructure 1 (Dependent Variable: Brand Image X3)

Model	B	Std. Error	Beta (β)	t / Sig.
(Constant)	2.645	2.337	—	t=1.132 / p=0.260
Product Differentiation (X1)	0.124	0.053	0.117	t=2.317 / p=0.022
Customer Experience (X2)	0.838	0.051	0.831	t=16.519 / p<0.001

Results for Substructure 1 show that X1 and X2 together explain 81.9% of the variance in Brand Image ($R^2 = 0.819$; error $\epsilon_1 = 0.426$). Customer experience (X2) is the dominant predictor ($\beta = 0.831$, $t = 16.519$, $p < 0.001$), while product differentiation (X1) also makes a significant though smaller contribution ($\beta = 0.117$, $t = 2.317$, $p = 0.022$). This confirms that the quality of experiential interactions is far more powerful than programmatic distinctiveness alone in shaping the school's brand image.

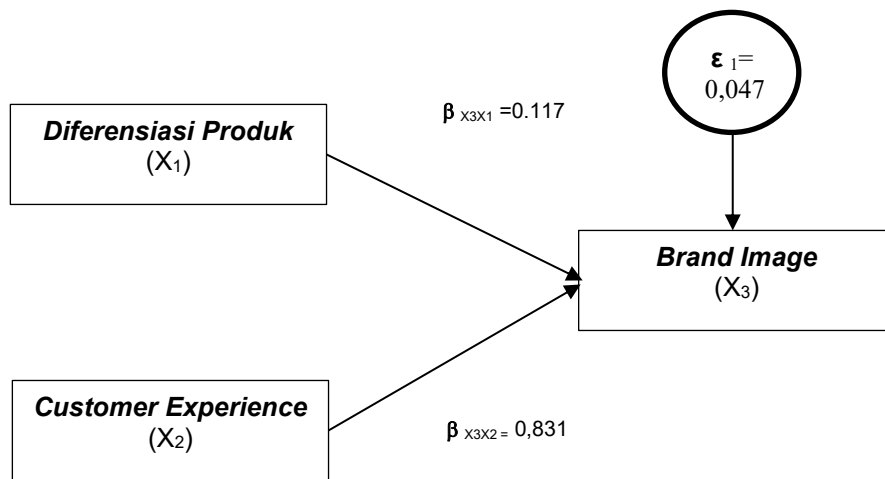


Figure 2 Path Diagram Substructure 1

Substructure 2: X1, X2, X3 → Y (School Selection Decision)

Table 10 Path Coefficients: Substructure 2

Model	B	Std. Error	Beta (β)	t / Sig.
(Constant)	-2.659	1.129	—	t=-2.355 / p=0.020
Product Differentiation (X1)	0.072	0.026	0.068	t=2.760 / p=0.007
Customer Experience (X2)	0.085	0.042	0.084	t=2.005 / p=0.047
Brand Image (X3)	0.851	0.041	0.853	t=20.712 / p<0.001

Results for Substructure 2 show that X1, X2, and X3 together explain 95.6% of the variance in School Selection Decision ($R^2 = 0.956$; error $\epsilon_2 = 0.044$). Brand Image (X3) is overwhelmingly the dominant predictor ($\beta = 0.853$, $t = 20.712$, $p < 0.001$), while Customer Experience (X2, $\beta = 0.084$, $p = 0.047$) and Product Differentiation (X1, $\beta = 0.068$, $p = 0.007$) each make positive but comparatively modest contributions. This finding confirms that parents' ultimate school selection decision is governed primarily by their overall perception and trust in the school's brand, even after controlling for specific program attributes and direct service experiences.

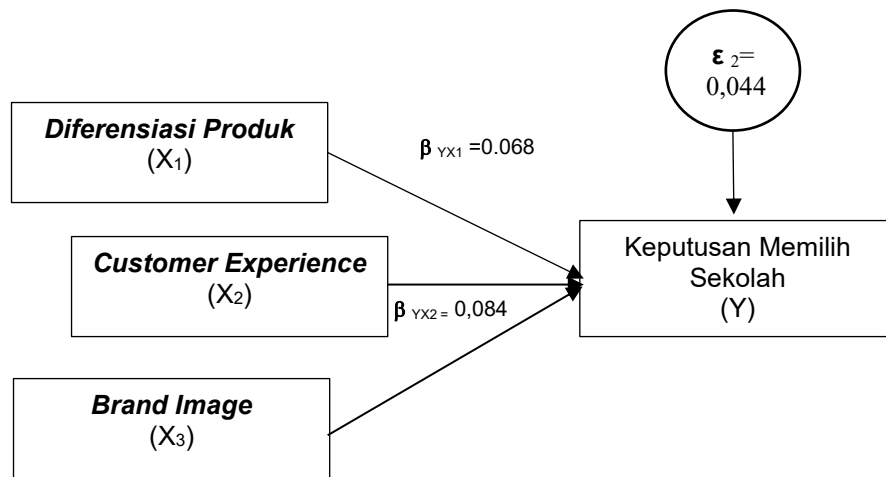


Figure 3 Path Diagram Substructure 2

Hypothesis Testing Summary

Table 11 Hypothesis Testing Summary

H	Path	β	t-calc.	t-table	Decision
H1	Product Differentiation (X1) → Brand Image (X3)	0.117	2.317	1.992	Supported ✓
H2	Customer Experience (X2) → Brand Image (X3)	0.831	16.519	1.992	Supported ✓
H3	Product Differentiation (X1) → School Selection (Y)	0.068	2.760	1.992	Supported ✓
H4	Customer Experience (X2) → School Selection (Y)	0.084	2.005	1.992	Supported ✓
H5	Brand Image (X3) → School Selection (Y)	0.853	20.712	1.992	Supported ✓

Discussion

- H1 (Product Differentiation → Brand Image, $\beta = 0.117$, $p = 0.022$) was supported. The unique educational programs of MI Tazkirunnas particularly the integration of Kurikulum Merdeka with pesantren-style Islamic character formation, Cambridge English, Arab Saudi Arabic, and Tahfidz serve as distinctiveness signals that contribute to a positive brand identity. However, the relatively modest coefficient suggests that programmatic differentiation alone is insufficient to drive strong brand image without being reinforced by superior service experiences (consistent with Aaker, 2018).
- H2 (Customer Experience → Brand Image, $\beta = 0.831$, $p < 0.001$) was strongly supported and represents the most important finding of Substructure 1. The overwhelming dominance of customer experience as a brand image driver confirms that parents form their institutional perceptions primarily through lived interactions administrative responsiveness, teacher communication quality, open house experiences, and especially the emotional bonds formed through the Habib Umar religious community. This aligns with Schmitt's (2020) experiential marketing theory and Chen & Lin's (2021) finding that emotional experiences create more durable brand associations than functional product attributes.
- H3 (Product Differentiation → School Selection Decision, $\beta = 0.068$, $p = 0.007$) was supported. While the direct coefficient is modest, it confirms that distinctive educational programming does independently influence parental choice particularly the combination of general academic excellence with strong Islamic values, which aligns with parents' expressed desires from preliminary interview data.

4. H4 (Customer Experience → School Selection Decision, $\beta = 0.084$, $p = 0.047$) was supported. Positive service experiences including professional administrative handling, warm teacher interactions, and inclusion in the school's religious community network meaningfully increase parents' confidence in selecting MI Tazkirunnas.
5. H5 (Brand Image → School Selection Decision, $\beta = 0.853$, $p < 0.001$) was most strongly supported and represents the dominant finding of the entire study. With 95.6% of variance in school selection decisions explained by the three variables combined, and brand image alone carrying a β of 0.853, this study confirms that the reputational and trustworthiness dimension of MI Tazkirunnas anchored by the religious authority and community credibility of Habib Umar Bin Hoed Al Athas is the primary driver of parental enrollment decisions. This is consistent with Keller (2020), Firmansyah (2018), and Sya'idah (2024), all of whom identified brand image as the critical determinant of educational institution selection.

The complete path model demonstrates a cascade mechanism: product differentiation and customer experience feed into brand image construction, which then powerfully translates into the final enrollment decision. Customer experience is the critical mediating amplifier — it transforms observable school programs into internalized brand perceptions. Strategic implication: improving CX quality is the highest-leverage intervention for strengthening both brand image and enrollment decisions simultaneously.

CONCLUSIONS, IMPLICATIONS & RECOMMENDATIONS

Conclusions

Based on path analysis (SPSS v.25) with $n = 140$ parents at MI Tazkirunnas, the following conclusions are drawn:

1. H1 Supported: Product differentiation has a direct positive and significant effect on Brand Image ($\beta = 0.117$, $t = 2.317$, $p = 0.022$). Distinctive programs strengthen institutional brand identity.
2. H2 Supported: Customer experience has the strongest direct positive effect on Brand Image ($\beta = 0.831$, $t = 16.519$, $p < 0.001$). The quality of parental interactions is the primary driver of brand image formation.
3. H3 Supported: Product differentiation has a direct positive and significant effect on School Selection Decision ($\beta = 0.068$, $t = 2.760$, $p = 0.007$). Programmatic uniqueness independently influences parental choice.
4. H4 Supported: Customer experience has a direct positive and significant effect on School Selection Decision ($\beta = 0.084$, $t = 2.005$, $p = 0.047$). Positive service interactions increase parental confidence and enrollment intention.
5. H5 Supported: Brand Image is the most dominant factor in School Selection Decisions ($\beta = 0.853$, $t = 20.712$, $p < 0.001$). Overall, the model explains 95.6% of variance in Y, with Brand Image as the dominant pathway.

The total path model demonstrates: $X1 + X2$ explain 81.9% of Brand Image variance (Substructure 1); $X1 + X2 + X3$ explain 95.6% of School Selection Decision variance (Substructure 2). Brand Image acts as a powerful mediating and direct force connecting programmatic and experiential inputs to enrollment outcomes.

Implications

For product differentiation: MI Tazkirunnas should continuously develop its unique educational

programs as a competitive differentiator, deepening the integration of Kurikulum Merdeka with Islamic character formation, consistently expanding the English and Arabic language programs, and publicizing the school's distinctive extracurricular and religious activities. Differentiation must be clearly communicated to create strong perceived value.

For customer experience: Given its dominant role in shaping brand image ($\beta = 0.831$), improving the quality of every parental touchpoint is the highest-priority intervention. This includes professional administrative services, responsive and warm teacher communication, high-quality open house experiences, and sustained engagement with the school's religious community network. Every interaction is a brand-building moment.

For brand image management: Brand image must be managed as a long-term strategic asset. This entails maintaining academic reputation, consistent publication of student achievements, preserving the school's religious atmosphere, sustaining the trust networks built around Habib Umar Bin Hoed Al Athas, and proactive communication of the school's accreditation and institutional excellence.

For evidence-based management: School management should adopt data-driven decision-making, using empirical findings like those of this study to prioritize investments in CX quality improvements, branding strategies, and program differentiation initiatives with the highest marginal impact on enrollment growth.

Recommendations

1. Strengthen product differentiation by continuously developing curriculum innovations that integrate general knowledge, Islamic values, and language mastery. Publish these program advantages systematically through all available media channels.
2. Elevate customer experience quality at every stage of the parent journey — from first inquiry and PPDB registration through graduation. Train all staff in responsive, professional, and empathetic service delivery. Document and respond to parent feedback systematically.
3. Manage brand image as a strategic asset: invest in regular publication of student academic and extracurricular achievements, maintain the credibility of religious activities and community partnerships, and build transparent communication channels with parents and the broader community.
4. Leverage the Habib Umar community network: the Jamaah Majelis represents a unique and powerful brand asset. Deepen engagement with this community through structured programs that connect prospective parents to the school's spiritual and educational ecosystem.
5. Conduct regular evaluation and monitoring: implement periodic surveys measuring parental satisfaction with product differentiation, customer experience, and brand image, and use these data to guide annual strategic planning for enrollment growth.

Limitations & Future Research

This study is limited to MI Tazkirunnas ($n = 140$), restricting generalizability across other Islamic elementary schools. The cross-sectional design captures perceptions at one point in time. Future research should: (1) replicate the study across multiple madrasah institutions for comparative insights; (2) include additional variables such as tuition fees, school location/accessibility, and digital marketing effectiveness; (3) examine the moderating role of parental religiosity or educational background on the brand image–selection decision relationship; and (4) employ longitudinal designs to track how customer experience cumulatively shapes brand image over multiple academic years.

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CHAPTER 10

Literature Study on the Effect of Adsorption on Recovery Factor Using Palm Oil-Based MES with 35° API and 48° API Crude Oils

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ABSTRACT

Surfactant injection is one of the Enhanced Oil Recovery (EOR) methods that is effective in reducing interfacial tension (IFT) and altering rock wettability to mobilize residual oil, thereby improving oil production. One of the surfactants that can be utilized is palm oil-based Methyl Ester Sulfonate (MES), an anionic and environmentally friendly surfactant. This study aims to analyze the impact of surfactant adsorption on the reduction of injected fluid concentration and its effect on the Recovery Factor (RF). The research was conducted through laboratory studies, including static adsorption tests using a UV-Vis spectrophotometer and experimental coreflooding using sandstone core samples. The observed parameters include surfactant concentration, adsorption value, IFT changes, and RF improvement after surfactant injection. Based on previous studies, MES surfactants are known to effectively reduce IFT and enhance oil recovery. However, excessive surfactant adsorption on reservoir rock surfaces remains a major challenge, as it decreases the effectiveness of surfactant injection. Therefore, adsorption control becomes a crucial factor in optimizing the performance of MES surfactants in EOR applications. The results of this study are expected to provide a foundation for the development of palm oil-based surfactants as a more economical and sustainable chemical agent for EOR applications.

Keywords: Enhanced Oil Recovery (EOR), Methyl Ester Sulfonate (MES), Recovery Factor

1. INTRODUCTION

1.1 Background

Oil production during the primary and secondary stages is generally only able to yield around 20-40% of the Original Oil In Place (OOIP), so that most of the oil reserves remain trapped in the reservoir in the form of residual oil saturation. To mobilize this remaining oil, an advanced-stage method known as Enhanced Oil Recovery (EOR) is required. One of the widely applied EOR methods is surfactant injection (surfactant flooding), which works by reducing the interfacial tension (IFT) between oil and water and altering rock wettability from an oil-wet to a water-wet condition, allowing oil trapped in the rock pores to move more easily toward the production well.

One of the surfactants with potential for use in EOR applications is palm oil-based Methyl Ester Sulfonate (MES). MES is an anionic surfactant derived from vegetable oil that is environmentally friendly, readily biodegradable, and abundantly available in Indonesia as the world's largest palm oil producer. Several studies have shown that MES surfactants can significantly reduce the oil-water interfacial tension and have potential for use as a well stimulation agent as well as in EOR for sandstone reservoirs.

However, one of the main challenges in applying surfactants in EOR is the occurrence of surfactant adsorption on the surface of reservoir rock. Excessive adsorption reduces the concentration of surfactant that reaches the target zone, thereby decreasing the effectiveness of IFT reduction and increasing operating costs due to the greater surfactant requirement. This adsorption phenomenon is generally evaluated through two laboratory testing approaches, namely the static adsorption test and the dynamic adsorption test using sandstone cores, with the surfactant concentration before and after contact measured using a UV-Vis spectrophotometer based on a standard absorbance calibration curve.

Based on the above, this literature study was prepared to comprehensively examine the phenomenon of palm oil-based MES surfactant adsorption on reservoir rock, compare the characteristics of static and dynamic adsorption, and examine its effect on the reduction of injected fluid concentration and the Recovery Factor (RF) based on experimental data and relevant prior studies.

1.2 Problem Statement

Based on the background above, the problem statements of this literature study are as follows:

1. How are the adsorption characteristics of palm oil-based MES surfactant on sandstone rock based on static and dynamic testing methods?
2. How does surfactant concentration affect the adsorption value measured using a UV-Vis spectrophotometer?
3. How does surfactant adsorption affect the reduction of injected fluid concentration and the Recovery Factor (RF) in the EOR process?

1.3 Objectives

1. Analyzing the characteristics and comparison of static and dynamic adsorption of palm oil-based MES surfactant on sandstone rock.
2. Analyzing the effect of surfactant concentration variation on the adsorption value detected through a UV-Vis spectrophotometer.

3. Examining the relationship between surfactant adsorption and the reduction of injected fluid concentration and its impact on the improvement of Recovery Factor (RF).

1.4 Benefits

This literature study is expected to provide a deeper understanding of the adsorption behavior of palm oil-based MES surfactant on reservoir rock, and to serve as a reference in the development of more economical, environmentally friendly, and sustainable vegetable-based surfactant formulations for EOR applications in the field.

2. LITERATURE REVIEW

2.1 Enhanced Oil Recovery (EOR)

Enhanced Oil Recovery (EOR) is an advanced oil production stage carried out after primary and secondary methods are no longer able to produce oil economically. The basic principle of EOR is to add energy or material from outside the reservoir to improve the oil-driving mechanism, either through improving the mobility ratio, reducing interfacial tension, or altering the wettability properties of the rock. One of the most well-known chemical EOR methods is surfactant flooding, which is considered effective in improving oil recovery through a combination of interfacial tension (IFT) reduction, wettability alteration, and emulsification.

2.2 Methyl Ester Sulfonate (MES) Surfactant

Methyl Ester Sulfonate (MES) is an anionic surfactant synthesized through the sulfonation reaction of fatty acid methyl esters, generally derived from vegetable oils such as palm oil. As a vegetable-based surfactant, MES has the advantage of being biodegradable and environmentally friendly compared to conventional petrochemical-based surfactants. Several studies have shown that palm oil-based MES is soluble in both the water and oil phases and effectively reduces the oil-water interfacial tension, making it potentially useful as a well stimulation agent as well as in EOR.

A study on the potential application of palm methyl ester sulfonate as an IFT-reducing surfactant for chemical EOR showed that this surfactant has good stability and compatibility with brine solutions without the formation of precipitates, although the strength of IFT reduction as a single surfactant has not reached the ultra-low IFT condition, so it is generally combined with other chemical components. Another study reported the development of a polymeric surfactant from palm oil MES that was able to significantly reduce the IFT value, from around 8.6 mN/m to 2.3 mN/m, indicating the potential for improving MES performance through modification of its molecular structure.

2.3 Surfactant Adsorption on Reservoir Rock

Surfactant adsorption is one of the main challenges in surfactant flooding applications because it causes the loss of some surfactant due to binding on the rock surface, thereby reducing the effective surfactant concentration available to reduce IFT within the reservoir. Excessive adsorption can make surfactant requirements uneconomical. The adsorption mechanism is influenced by various factors, including surfactant concentration, salinity, pH, temperature, and rock mineralogy characteristics, including the presence of clay minerals and asphaltene on the surface of sandstone rock.

A study on the static adsorption of anionic surfactant on crushed Berea sandstone reported that the maximum adsorption value obtained was 0.96 mg/g, and that surfactant performance improved under conditions of high pH, high temperature, and low salinity. Another study on the adsorption equilibrium of vegetable oil-derived surfactant (Gemini surfactant) on sandstone and carbonate rock using static and dynamic UV-Vis-based approaches showed that the dynamic adsorption value was much lower than the static adsorption value, with a maximum dynamic adsorption capacity of only around 0.013 mg/g on sandstone rock, compared to a much higher static adsorption value.

A study on the synergy of MES and nano-silica on sandstone rock reported that the addition of nano-silica was able to reduce the maximum surfactant adsorption capacity from 4.66 mg/g to 0.85 mg/g, while also changing the rock wettability from oil-wet to more water-wet, which contributed to improved oil recovery. This confirms that controlling surfactant adsorption not only affects cost efficiency but is also closely related to the wettability alteration mechanism, which is one of the keys to EOR success.

2.4 Static and Dynamic Adsorption Testing Methods

The static adsorption test is generally carried out by contacting the surfactant solution with crushed rock samples under static (batch) conditions, then allowing it to reach equilibrium for a certain period of time before the solution concentration is measured. In contrast, the dynamic adsorption test is carried out by flowing the surfactant solution through an intact rock core using a coreflood setup, thereby better representing the actual fluid flow conditions occurring within the reservoir. Generally, the dynamic coreflood procedure begins with core saturation using formation water, followed by injection of the surfactant solution until the effluent concentration approaches the injection concentration, and then followed by a water flooding stage to observe desorption behavior.

Quantification of surfactant concentration in both testing methods is generally carried out using a UV-Vis spectrophotometer, by first creating a standard solution calibration curve to obtain a linear relationship between absorbance value and surfactant concentration. The adsorption value is then calculated based on the difference in surfactant concentration before and after the adsorption process, multiplied by the solution volume and divided by the mass of rock used.

2.5 Relationship between Surfactant Adsorption and Recovery Factor

Several studies have shown that controlled surfactant adsorption can make a positive contribution to rock wettability alteration, but when excessive, it instead reduces the effective surfactant concentration within the reservoir, thereby reducing the ability to lower IFT and negatively impacting the Recovery Factor. A comparative study of the performance of palm oil-derived surfactants, including MES and alkyl sulfate, against the synthetic surfactant SDBS in sandstone reservoirs reported that palm oil-based surfactants showed good adsorption performance and oil recovery, with the highest oil recovery obtained from the surfactant with the lowest adsorption level and highest solubility. This finding indicates that the lower the adsorption level of a surfactant on reservoir rock, the greater the potential improvement in Recovery Factor that can be achieved.

3. LITERATURE STUDY METHODOLOGY

This study was prepared using a literature review approach, carried out by examining and comparing data from adsorption tests of palm oil-based MES surfactant against relevant findings from prior research on surfactant adsorption on reservoir rock for EOR applications. The primary data examined consists of the

results of static and dynamic adsorption tests at two surfactant concentration variations, namely 0.75% and 2.00%, measured using a UV-Vis spectrophotometer based on a standard calibration curve with the equation $y = 0.1768x$ and a coefficient of determination $R^2 = 0.9843$.

The concentration value of the adsorbance solution is calculated using the calibration curve equation, then compared between the absorbance values before and after the flooding process to obtain the detected surfactant concentration value (%) and the adsorption value (mg/g). The test result data was then analyzed descriptively and comparatively with reference to various literature related to the adsorption of MES surfactant and similar anionic surfactants on sandstone rock, in order to obtain a more comprehensive interpretation of the adsorption phenomenon and its implications for EOR performance.

4. RESULTS AND DISCUSSION

4.1 Standard Absorbance Calibration Curve

Based on the standard adsorption curve, a linear regression equation of $y = 0.1768x$ was obtained with a coefficient of determination $R^2 = 0.9843$. The R^2 value approaching 1 indicates that the calibration curve has a very good linear relationship between absorbance and standard solution concentration, making it suitable for use as the basis for calculating the surfactant solution concentration read by the UV-Vis spectrophotometer in all static and dynamic adsorption tests in this study.

4.2 Adsorption Test Results at 0.75% Concentration

Table IV.1. Static and Dynamic Adsorption Test Results at 0.75% Concentration

Adsorption Type	Concentration (%)	Absorbance Before Flooding	Absorbance After Flooding	Detected Concentration (%)	Adsorption (mg/g)
Dynamic	0,75	2,369	0,074	0,210	1
Static	0,75	2,369	0,323	0,583	6

At a surfactant concentration of 0.75%, the test results show that the initial absorbance value (before flooding) for both test methods was the same, namely 2.369, since it originated from the same parent surfactant solution. After the flooding process, the absorbance value in the dynamic test decreased sharply to 0.074, while in the static test it decreased to 0.323. The larger decrease in absorbance in the dynamic test indicates that the surfactant concentration remaining in the solution (detected) was much smaller, at 0.210%, compared to the static test at 0.583%.

However, the calculated adsorption value actually showed the opposite pattern, namely that the static adsorption (6 mg/g) was much higher than the dynamic adsorption (1 mg/g). This is consistent with the basic principle that the adsorption value (mg/g) is not solely determined by the magnitude of the absorbance decrease, but rather by the mass of surfactant truly and permanently bound to the rock solid surface relative to the mass of rock used. In the static test, the crushed rock has a much larger contact surface area and a longer contact time under static (batch) conditions, allowing the surfactant to reach a condition close to adsorption equilibrium and bind more to the solid surface. Conversely, in the dynamic test, the surfactant

solution flows through the intact rock core with a much shorter contact time, so the adsorption process does not fully reach equilibrium, even though a decrease in concentration in the solution phase is still observed due to some surfactant being retained within the pores as well as the possibility of dispersion or flow channeling within the core.

4.3 Adsorption Test Results at 2.00% Concentration

Table IV.2. Static and Dynamic Adsorption Test Results at 2.00% Concentration

Adsorption Type	Concentration (%)	Absorbance Before Flooding	Absorbance After Flooding	Detected Concentration (%)	Adsorption (mg/g)
Dynamic	2,00	0,925	0,721	0,974	0,974
Static	2,00	0,925	0,636	0,542	0,542

At a surfactant concentration of 2.00%, the initial absorbance value before flooding for both methods was 0.925. After the flooding process, the absorbance of the dynamic test decreased to 0.721, while the absorbance of the static test decreased more, to 0.636. Unlike the pattern at 0.75% concentration, at this 2.00% concentration the detected concentration value and adsorption value of the dynamic test (0.974%; 0.974 mg/g) were actually higher than those of the static test (0.542%; 0.542 mg/g).

The difference in pattern between the two concentrations shows that the adsorption behavior of MES surfactant is not always linear and can be influenced by more complex mechanisms at higher concentrations. One explanation commonly found in the literature is that at surfactant concentrations approaching or exceeding the Critical Micelle Concentration (CMC), micelle formation in the solution can affect the amount of free surfactant monomer available for adsorption on the rock surface, so the adsorption pattern between static and dynamic conditions can differ depending on the concentration tested. In addition, under dynamic conditions at high concentrations, limited contact time can cause some surfactant to undergo only temporary (reversible) surface adsorption, which is then measured as a decrease in effluent absorbance, but does not necessarily represent permanent adsorption as in the static condition.

4.4 Comparison of Static and Dynamic Adsorption and Its Relation to the Literature

In general, the finding that the static adsorption value at low concentration (0.75%) is higher than the dynamic adsorption value is consistent with various previous studies. A study on the adsorption of vegetable oil-based Gemini surfactant on sandstone and carbonate rock reported that the dynamic adsorption value was consistently much lower than the static adsorption value, with a maximum dynamic adsorption capacity of only around 0.013 mg/g, because the flowing condition limits the contact time between the surfactant and the rock surface, so adsorption does not reach equilibrium as in static batch testing. This is further reinforced by a study on the static adsorption of anionic surfactant on crushed Berea sandstone, which reported a maximum adsorption value of up to 0.96 mg/g under certain optimum pH and temperature conditions.

For comparison, the adsorption values in this study range from 0.542 to 6 mg/g, which is relatively higher than several anionic surfactant adsorption values in the literature above. This may be due to differences in the mineralogical characteristics of the test rock, the specific surface area of the sample (crushed rock being

larger than an intact core), the ratio of rock mass to solution volume, as well as differences in the molecular structure and functional groups between palm oil-based MES surfactant and other anionic surfactants such as SDBS and Gemini surfactant examined in the comparative studies.

The phenomenon of reduced adsorption due to the addition of additives such as nano-silica, as reported in the study on MES and nano-silica synergy in which the maximum adsorption capacity was successfully reduced from 4.66 mg/g to 0.85 mg/g, indicates that the adsorption value of MES surfactant under conditions without additives indeed has the potential to be in a relatively high range, so the results in this study are generally still within a reasonable range for a pure MES system without the addition of an adsorption-reducing agent.

4.5 Implications for Recovery Factor (RF)

The high adsorption values of the surfactant, particularly in the static test at 0.75% concentration and the dynamic test at 2.00% concentration, indicate the potential for significant loss of active surfactant during the injection process within the reservoir. As explained in the comparative study of palm oil-based surfactant performance, the lower the adsorption of a surfactant on reservoir rock, the higher the oil recovery that can be achieved, because the effective surfactant concentration available to reduce IFT and alter rock wettability is maintained throughout the flooding process.

Thus, the high adsorption of MES surfactant under certain conditions, as shown in the test results in this study, has the potential to reduce the effectiveness of Recovery Factor improvement if not balanced with an adsorption control strategy, such as through optimization of injection concentration, the addition of additives such as alkali or nanoparticles, or combination with polymer to improve the mobility ratio and reduce surfactant loss due to adsorption on the rock surface.

5. CONCLUSION

5.1 Conclusion

1. The standard absorbance calibration curve produced the equation $y = 0.1768x$ with $R^2 = 0.9843$, which shows a very good linear relationship and is suitable for use as the basis for determining MES surfactant concentration through a UV-Vis spectrophotometer.
2. At a surfactant concentration of 0.75%, the static adsorption value (6 mg/g) is much higher than the dynamic adsorption value (1 mg/g), whereas at a concentration of 2.00% this pattern is reversed, with the dynamic adsorption value (0.974 mg/g) higher than the static adsorption value (0.542 mg/g), indicating that MES adsorption behavior is influenced by the interaction between surfactant concentration and the testing method used.
3. The fundamental difference between the static and dynamic methods lies in the contact surface area and contact time between the surfactant and the rock, where the batch condition in the static test generally allows for better achievement of adsorption equilibrium compared to the flow condition in the dynamic test.
4. High surfactant adsorption has the potential to reduce the effective concentration of injected fluid within the reservoir, which can ultimately reduce the effectiveness of IFT reduction and hinder the improvement of Recovery Factor if not controlled.

5. Palm oil-based MES surfactant remains a potential economical and environmentally friendly EOR material, but additional strategies such as the use of additives or concentration optimization are needed to control its adsorption level on reservoir rock.

5.2 Recommendations

Further research is needed on the addition of additives such as nanoparticles, alkali, or polymers to reduce the adsorption level of palm oil-based MES surfactant on reservoir rock, as well as studies on the effect of salinity, temperature, and pH on static and dynamic adsorption behavior, so that the performance of MES surfactant in improving Recovery Factor can be further optimized for field EOR applications.

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CHAPTER 11

ALKALINE – SURFACTANT PHASE BEHAVIOR EVALUATION FOR EOR

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ABSTRACT

Chemical Enhanced Oil Recovery (CEOR) method uses chemical injection as one of crucial strategies to increase oil recovery factor in mature fields. This research aims to evaluate the results of phase behavior tests of alkali–surfactant solution formulations for EOR applications. The evaluation focuses on salinity scan experiments under reservoir temperature conditions to obtain data on microemulsion type formed and the solubilization ratio. The solubilization ratio is used to estimate interfacial tension (IFT) through the theoretical correlation between IFT and the oil–water solubilization ratio developed by Huh. The phase behavior test results indicate that the interaction of alkali–surfactant solutions from surfactant X546 and cosurfactant Z16 successfully formed a stable Winsor type III microemulsion at surfactant X546 concentrations of 0.7–0.8 wt.%. The calculated interfacial tension values of the alkali–surfactant solutions forming type III microemulsions show that the system reached ultra-low values (on the order of 10^{-3} dynes/cm), thereby producing a capillary number greater than the capillary pressure trapping residual oil and enabling mobilization of the remaining oil within the reservoir pores. Overall, the phase behavior test results demonstrate that the tested alkali–surfactant formulation is compatible with reservoir fluids and thus has promising potential for field-scale implementation to optimize sweep efficiency and enhance production.

Key words: Chemical Enhanced Oil Recovery (CEOR), Alkali-Surfactant, Phase Behavior, Interfacial Tension, Microemulsion.

INTRODUCTION

Energy demand has been increasing parallel to increase in populations and industrialization. Oil has been a major energy source and is expected to continue contributing significantly. Exploration activities to find new fields and technological advancements that allowed hydrocarbon production from non-conventional reservoirs are examples of the attempt to maintain R/P (Reserves-to-Production) ratio. According to (Sheng, 2011) Enhanced Oil Recovery (EOR) refers to oil recovery method by injection of either gases, chemicals and/or thermal energy into reservoir that has relatively lower risk than exploration activities. Reservoir target and fluid characteristics have been both identified from primary and secondary activities thus lowering the risk of missing reservoir target or dealing with reservoir fluids with complex handling requirements. Chemical EOR (CEOR) uses either alkaline, surfactant and/or polymer injections. Modern CEOR progress is advanced significantly due to improvements in chemical formulation technology, more rigorous laboratory screening methods and improved reservoir characterization techniques.

This paper discusses the process of identifying and evaluating potential CEOR alkaline – surfactants for one of mature Sumatra Light Oil Field. The first production of the field can be traced back to 1952 with primary recovery. In 1970, the field started its waterflood campaign for pressure maintenance and reached its peak production in 1973. From the increasing number of barrels of water injected (light blue graph) and growing number of its injector well count, waterflood campaign in the field has entered mature stage of its waterflood campaign. As the volume of water injected no longer gives incremental in oil production nor even can sustain the decline rate, thus tertiary recovery through EOR method emerges as a potential solution to optimize oil recovery factor of the field.

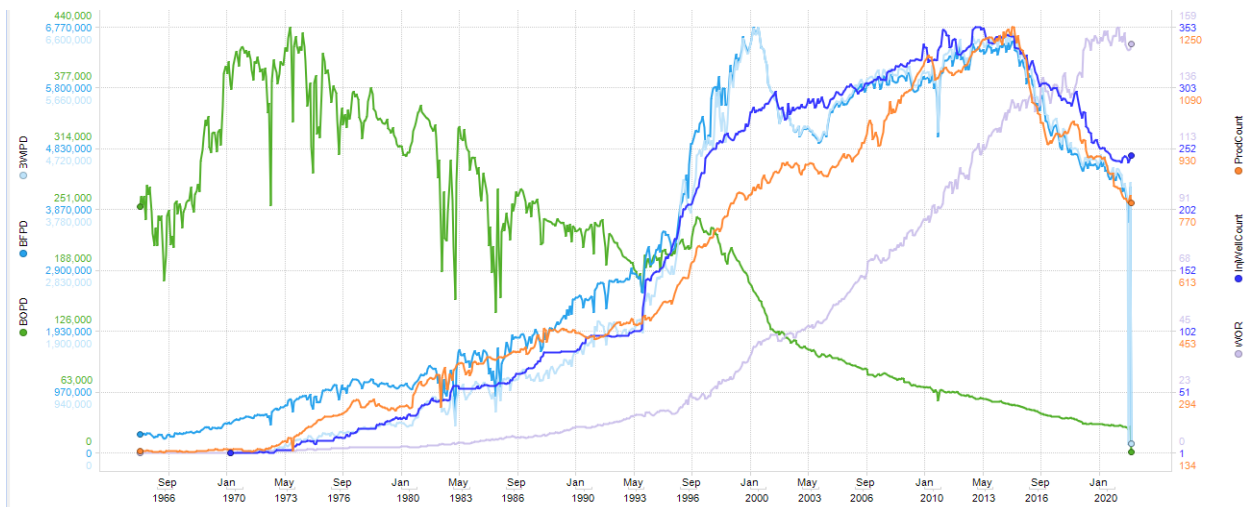


Figure 3. Field Historical Production

Given the wide range of potential injectants for EOR method, this paper applies Taber’ screening criteria as a systematic basis for selecting the most suitable options.

Table 1. Screening criteria untuk ASP flooding (Taber, Martin, & Seright, 1997)

Detail Table in Ref. 16	EOR Method	Oil Properties			Reservoir Characteristics					
		Gravity (°API)	Viscosity (cp)	Composition	Oil Saturation (% PV)	Formation Type	Net Thickness (ft)	Average Permeability (md)	Depth (ft)	Temperature (°F)
Gas Injection Methods (Miscible)										
1	Nitrogen and flue gas	>35 / <u>48</u> /	<0.4 \ 0.2 \	High percent of C ₁ to C ₇	>40 / <u>75</u> /	Sandstone or carbonate	Thin unless dipping	NC	>6,000	NC
2	Hydrocarbon	>23 / <u>41</u> /	<3 \ 0.5 \	High percent of C ₂ to C ₇	>30 / <u>80</u> /	Sandstone or carbonate	Thin unless dipping	NC	>4,000	NC
3	CO ₂	>22 / <u>36</u> / ^a	<10 \ 1.5 \	High percent of C ₅ to C ₁₂	>20 / <u>55</u> /	Sandstone or carbonate	Wide range	NC	>2,500 ^a	NC
1-3	Immiscible gases	>12	<600	NC	>35 / <u>70</u> /	NC	NC if dipping and/or good vertical permeability	NC	>1,800	NC
(Enhanced) Waterflooding										
4	Micellar/Polymer, ASP, and Alkaline Flooding	>20 / <u>35</u> /	<35 \ 13 \	Light, intermediate, some organic acids for alkaline floods	>35 / <u>53</u> /	Sandstone preferred	NC	>10 / <u>450</u> /	>9,000 \ 3,250	>200 \ 80
5	Polymer Flooding	>15	<150, >10	NC	>50 / <u>80</u> /	Sandstone preferred	NC	>10 / <u>800</u> / ^b	<9,000	>200 \ 140
Thermal/Mechanical										
6	Combustion	>10 / <u>16</u> →?	<5,000 ↓ <u>1,200</u>	Some asphaltic components	>50 / <u>72</u> /	High-porosity sand/ sandstone	>10	>50 ^c	<11,500 \ 3,500	>100 / <u>135</u>
7	Steam	>8 to 13.5 →?	<200,000 ↓ <u>4,700</u>	NC	>40 / <u>66</u> /	High-porosity sand/ sandstone	>20	>200 / <u>2,540</u> / ^d	<4,500 \ 1,500	NC
—	Surface mining	7 to 11	Zero cold flow	NC	>8 wt% sand	Mineable tar sand	>10 ^e	NC	>3:1 overburden to sand ratio	NC
NC = not critical. Underlined values represent the approximate mean or average for current field projects. ^a See Table 3 of Ref. 16. ^b >3md from some carbonate reservoirs if the intent is to sweep only the fracture system. ^c Transmissibility > 20 md-ft/cp ^d Transmissibility > 50 md-ft/cp ^e See depth.										

The field is considered as light oil field with oil gravity of 36° API. Produced from sandstone reservoir with average permeability of 4,191 mD and reservoir temperature of 161° F. In consequence, ASP flooding is the most suitable injectant to be used. ASP flooding uses alkaline, surfactant and/or polymer to reduce interfacial tension (IFT) between oil and the displacing fluid. Because of the key mechanism is lowering IFT, ASP flooding is associated with the increased capillary number, which is a dimensionless ratio of viscous-to-local capillary forces. (Lake, 1989). (Willhite & Green, 1998) noted that the interfacial tension between water and pure hydrocarbons typically falls in the range of 30 to 50 dynes/cm, which is why ultra-low interfacial tension (IFT) values required for effective chemical EOR are typically on the order of 10⁻³ dynes/cm. Reducing IFT can be done with surfactant injection, but in modern CEOR, the most important processes are to reduce amount of injected chemicals and to fully explore the synergy of different process. This is reflected in Alkaline – Surfactant (AS) chemical candidates that will be used for the screening.

In CEOR injection, alkali is utilized to saponify crude oils with a Total Acid Number (TAN) greater than 0.5 mg KOH, thereby generating in-situ surfactants (Ehrlich & Wygal, 1977). Alkali also functions as a buffer solution and reduces surfactant adsorption. (Castor, Somerton, & Kelly, 1981) observed that alkali flooding produced interfacial tensions of only about 10 dynes/cm, while McCaffery (McCaffery, 1976) reported that sodium hydroxide interacting with oils of varying TAN initially formed surfactants but, upon reaching equilibrium, these dissolved into the aqueous phase. Collectively, these findings demonstrate that alkali flooding alone cannot achieve the ultralow IFT required for effective EOR. Hence, in this study alkali is applied primarily as a buffer solution and to minimize excessive surfactant adsorption by reservoir rock.

Sodium carbonate is selected to be used in this study to mitigate the excessive pH typically associated with hydroxide injection and to prevent silicate precipitation that commonly occurs when using sodium orthosilicate. There is still a chance that carbonate precipitation might be occur, but compared to hydrated

flocculent silicate precipitation that could significantly reduce reservoir permeability, granular carbonate precipitation is less prone to adhere to the rock surface, and if such precipitation still cause skin damage to the reservoir, acidizing or application of inhibitor still can be the option to restore reservoir performance.

Surfactant, surface-active agent, is a substance that at low concentrations dissolves in a system and adsorbs at the surface or interface, thereby altering the interfacial free energy (Rosen, 2004). Thus, will be used as the main chemicals to achieve ultra-low IFT. (Winsor, 1954) described surfactant/oil/water microemulsions as Type I (oil-in-water), Type II (water-in-oil), and Type III (bicontinuous oil and water in microemulsion), with Type III systems exhibiting the lowest interfacial tension. Therefore, this study aims to achieve Type III microemulsions from three selected anionic surfactants to identify the most compatible formulation with the reservoir fluid. Anionic surfactant was chosen because the reservoir rock is sandstone, which typically exhibits a negatively charged surface, thus it is expected to minimize surfactant adsorption to the rock surface. Nonionic surfactants also remain as potential candidates, since their neutrally charged head and have tolerance to high salinity environments. However, their relatively higher cost makes them less attractive as main surfactant for this study where reservoir fluids do not present significant salinity challenges. Nonionic surfactant will be used as cosurfactant to help reduce IFT more efficiently, improving emulsification and enhanced stability of the emulsion by preventing phase separation.

Other chemicals used in this study are Ethylene Glycol Butyl Ether (EGBE) that is frequently incorporated into chemical formulations to enhance system stability and performance. Its presence helps suppress undesirable phenomena such as gel formation, emulsion crystallization, and phase separation, thereby maintaining homogeneity over extended storage periods. Beyond stabilizing the physical structure, EGBE also accelerates the attainment of equilibrium within the system, effectively shortening the time required for phase balance. Moreover, EGBE contributes to lowering the viscosity of microemulsions, which not only facilitates easier handling and processing but also improves the efficiency of active ingredient delivery. Collectively, these attributes highlight the multifunctional role of EGBE as both a stabilizer and performance enhancer in complex chemical formulations.

EXPERIMENTAL PROCEDURES

Test Samples

The oil sample employed in this study was collected from one of the light oil fields located in Sumatra. Its characteristics have been previously established and are summarized in Table 2. To ensure that the analysis reflected the intrinsic properties of the crude oil, the sample was subjected to centrifugation prior to testing. This step effectively separated the oil from any residual water, associated gas, or other impurities, thereby providing a purified sample suitable for subsequent experimental evaluation.

Tabel 2. Oil Sample Characteristics

	Value
Oil Gravity (°API)	36
Viscosity (cP)	3.3
Reservoir Temperature (°F)	161

Synthetic brine was used to replicate the salinity of natural reservoir brine while simplifying the experimental procedure. The use of synthetic brine ensured that the samples maintained consistent composition and reproducibility throughout the experiments. This approach also facilitated phase behavior testing without the risk of contamination. Another important consideration is that real brine can undergo compositional changes over time due to precipitation, oxidation, and microbial growth, which may compromise experimental accuracy. By contrast, synthetic brine provided a stable and controlled medium, thereby improving the reliability of the results obtained.

Tabel 3. Synthetic Brine Sample Compositions

Massa (gram)	
NaCl	5.466
Na₂SO₄	0.052
NaHCO₃	6.206
KCl	0.361
De-ionized water	987.915

Alkali used in this study is the weak base sodium carbonate (Na₂CO₃), with concentrations varied from 1.6% to 3.0% in increments of 0.1%. This concentration range was selected based on previous research to accelerate the screening process. For the surfactant component, three samples (X546, R113, and R114) and two cosurfactants (Z16 and Z12) were tested. The surfactant and cosurfactant compositions were fixed at 1% each, referring to economic considerations from earlier pilot projects which indicated that concentrations exceeding 1% by mass were no longer cost-effective. Ethylene Glycol Monobutyl Ether (EGBE, C₆H₁₄O₂) was also added to the alkali–surfactant solution as a constant variable at 2% by mass. Thus, the alkali–surfactant solutions tested in this study consisted of combinations of surfactant, cosurfactant, and Na₂CO₃ at varying concentrations, together with EGBE as a fixed additive.

Tabel 4. Chemicals Characterization

Chemicals	Fungsi	Chemical Description	Active Concentration	Test Concentration
EGBE	Cosolvent	Ethylene Glycol Monobutyl Ether (C ₆ H ₁₄ O ₂)	99%	2%
Sodium Carbonate	Alkaline	Na ₂ CO ₃	100%	1.6% - 3%
X546	Anionic Surfactant	C10-13 linear alkyl benzene sulfonic acid	30%	0.6% - 0.8%
R113	Anionic Surfactant	C16-24 alkyl benzene sulfonic acid	40%	0.6% - 0.8%
R114	Anionic Surfactant	C16-24 alkyl benzene sulfonic acid	40%	0.6% - 0.8%
Z16	Nonionic Cosurfactant (EO grup)	Poly(oxy-1,2-ethanediyl), .alpha.-tridecyl-.omega.-hydroxy-, branched	100%	0.2% - 0.4%
Z12	Nonionic Cosurfactant (EO grup)	Isotridecanol, ethoxylated	100%	0.2% - 0.4%

Salinity Scan

In the salinity scan, the alkali–surfactant–brine–oil system was tested in pipettes with a volume of 5 mL. The upper and lower ends of the pipettes were sealed by flame to isolate the solution and prevent evaporation or contact with oxygen. Phase behavior changes were observed visually and documented with photographs. The formation of microemulsions was monitored at reservoir temperature for seven days or until equilibrium was reached, as indicated by no change in phase volumes for 24 hours. Visual observation data, including the measured levels of oil, microemulsion, and aqueous phases, were used to calculate the solubilization ratio, thereby determining the optimum salinity and interfacial tension (IFT). (Healy, Reed, & Stenmark, 1986) introduced the concept of optimum salinity in relation to Type III microemulsions. By measuring the volumes of oil and water solubilized per unit volume of surfactant in the middle phase, they defined optimum solubilization as the point where the oil and water solubilization ratios intersect.

In theory, microemulsions should appear transparent or translucent; however, in practice they may mix with oil, making it difficult to distinguish the microemulsion boundary. Special attention was therefore required to accurately identify phase boundaries. After obtaining the surfactant composition that produced a Winsor type III microemulsion and the corresponding optimum salinity, the study proceeded by processing the phase volumes formed during the salinity scan as input for the Huh correlation. The solubilization ratio of oil and brine was then used to calculate IFT using this correlation. (Huh, 1979) developed a theoretical relationship linking the oil and water solubilization ratio (σ) to IFT (γ), providing a predictive framework that connects phase behavior observations with quantitative IFT value as follows:

$$\gamma = \frac{C}{\sigma^2} \quad (1)$$

Where C is approximately 0.3 dynes/cm for typical crude oil and surfactant used for EOR. Many paper published since 1979 have shown that this equation accurately models the IFT of microemulsion and oil or water.

The alkali concentration varied to represent salinity changes, ranging from 1.6% to 3.0%, based on optimum salinity values reported in previous studies. This restricted range was expected to simplify the analysis by avoiding the need for broader salinity testing. The maximum alkali concentration tested was 3.0%, consistent with earlier findings that concentrations above this level no longer provided positive economic feasibility.

The total concentration of surfactant and cosurfactant was limited to 1.0%, reflecting the highest concentration still considered practical for field application while maintaining economic viability. Accordingly, three surfactant–cosurfactant compositions were prepared:

1. Surfactant 0.6% + Cosurfactant 0.4%
2. Surfactant 0.7% + Cosurfactant 0.3%
3. Surfactant 0.8% + Cosurfactant 0.2%

Ethylene Glycol Monobutyl Ether (EGBE) was maintained at a constant concentration of 2% in all alkali–surfactant mixtures, based on previously identified optimum formulations. EGBE served as a controlled variable, while alkali and surfactant compositions were treated as independent variables.

The solutions were introduced into serological pipettes in the following order: alkali, deionized water, synthetic brine, surfactant–cosurfactant solution, and oil sample. This sequence ensured that no aqueous phase reacted prematurely before the pipettes were sealed and mixed. The sealed pipettes were then placed in an oven at 60 °C, corresponding to reservoir temperature, to improve the accuracy of phase behavior testing, as temperature strongly influences phase transitions. Microemulsion formation was observed without removing the pipettes from the oven to avoid temperature fluctuations during the experiment. Visual identification of microemulsions was challenging when the expected transparent or translucent phase mixed with the oil sample. To distinguish phase boundaries, a flashlight was used: microemulsions exhibited light scattering or fluorescence, whereas the oil phase did not transmit or scatter light.

RESULT AND DISCUSSIONS

Salinity Scan Results

Salinity scan experiments with surfactant X546 and cosurfactant Z16 revealed that only specific formulations produced Type III microemulsions. At salinities between 1.6% and 3% with 2% EGBE, the mixtures of 0.8% X546 + 0.2% Z16 and 0.7% X546 + 0.3% Z16 generated Type III microemulsions on the seventh day of observation. These conditions yielded intersections in the oil-to-brine solubilization ratio

curves, indicating the optimum salinity window.



Figure 4. Salinity Scan Result on Seventh Day of 0.7% X546 and 0.3% Z16 (a); 0.8% X546 and 0.2% Z16 (b)

In contrast, the formulation containing 0.6% X546 and 0.4% Z16 produced Type III microemulsions only at 3% salinity, providing limited solubilization data. To expand the dataset, the salinity range was extended to 2.7%–3.4% and the EGBE concentration increased to 2.5%. The higher salinity was expected to stabilize the microemulsion by preventing complete dissolution into the brine phase, while the elevated EGBE concentration was intended to enhance lipophilicity of the system.

On the seventh day of observation, the formulation containing 0.6% X546 and 0.4% Z16 with 2.5% EGBE produced Type III microemulsions only at salinities of 3.3% and 3.4%. Although salinity was increased to drive the microemulsion out of the aqueous phase and EGBE concentration was raised to enhance lipophilicity, these adjustments were insufficient to shift the system toward stronger oil solubilization. The relatively low surfactant concentration (0.6%) compared to the successful formulations (0.7% and 0.8%) limited interfacial coverage, preventing adequate solubilization even with added EGBE.



Figure 5. Salinity Scan Result on Seventh Day of 0.6% X546 and 0.4% Z16 Before Adding EGBE Concentration and Salinity Range (a); 0.6% X546 and 0.4% Z16 After Adding EGBE Concentration and Salinity Range (2.7%–3.4%) (b)

EGBE, an amphiphilic solvent with a hydrophilic ethylene glycol group and a lipophilic butyl chain, acts at the interface to reduce electrostatic repulsion and improve oil solubilization. However, in this system, the insufficient surfactant concentration caused the interface to lose its ability to retain oil, pushing the optimum salinity to higher values. Further testing at higher salinities was not pursued, as the solubilization ratio trends indicated that the optimum would lie well beyond the economically feasible range for field application. These results confirm that the EGBE concentration is already optimal at 2% and increasing it does not compensate for inadequate surfactant loading.

The X546–Z12 formulations produced microemulsions that dissolved in the aqueous phase, classified as Type I, across all tested concentrations within the salinity range of 1.6%–3%. No Type III microemulsions

were observed, and therefore additional salinity range testing was not pursued for this system.

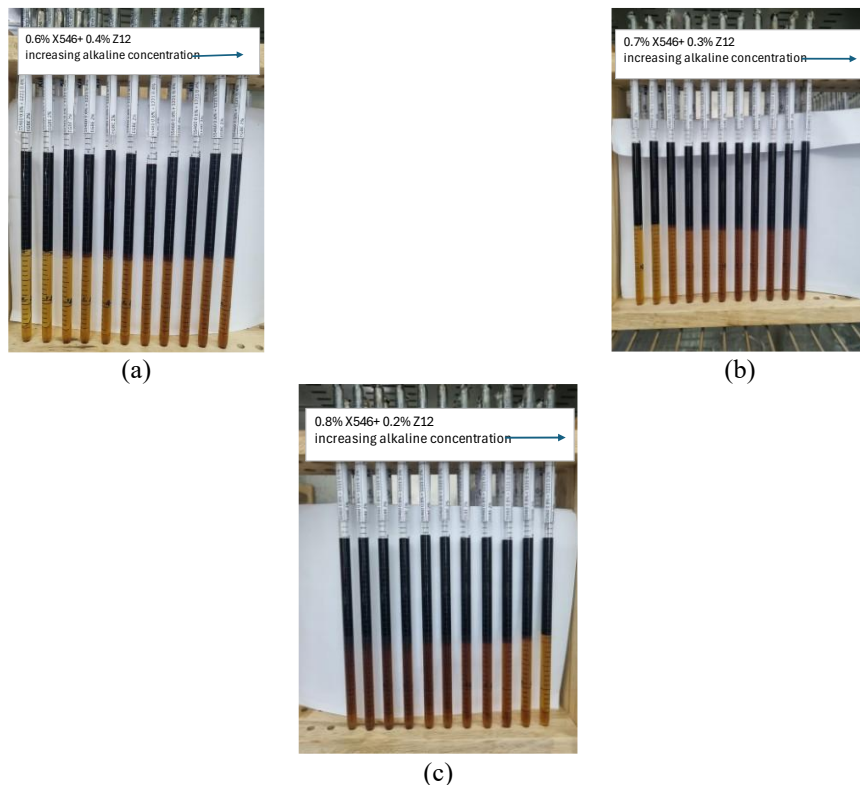


Figure 6. Salinity Scan Result on Seventh Day of 0.6% X546 and 0.4% Z12 (a); 0.7% X456 and 0.3% Z12 (b); and 0.8% X546 and 0.2% Z12 (c)

Following the evaluation of surfactant X546, tests with surfactant R114 combined with cosurfactant Z16 consistently produced Type II microemulsions, dissolving into the oil phase across all concentrations and salinity ranges. This indicates that the R114 and cosurfactant Z16 system requires lower salinity than the tested range to partition into the aqueous phase, a condition not feasible under field constraints. Observations on day seven confirmed the persistence of Type II behavior.

Subsequent tests with surfactant R113 and Z16 at 0.6% R113 and 0.7% R113 also yielded Type II microemulsions in the oil phase. Given this consistent trend, further optimization with 0.8% R113 and 0.2% Z16 was not pursued. Similarly, combinations of R114 and R113 with cosurfactant Z12 were not tested, as all the R113 and R114 with Z16 systems already demonstrated Type II behavior across all conditions. Since surfactant–cosurfactant interactions are not strictly linear, additional phase behavior studies with Z12 remain necessary to confirm potential differences.



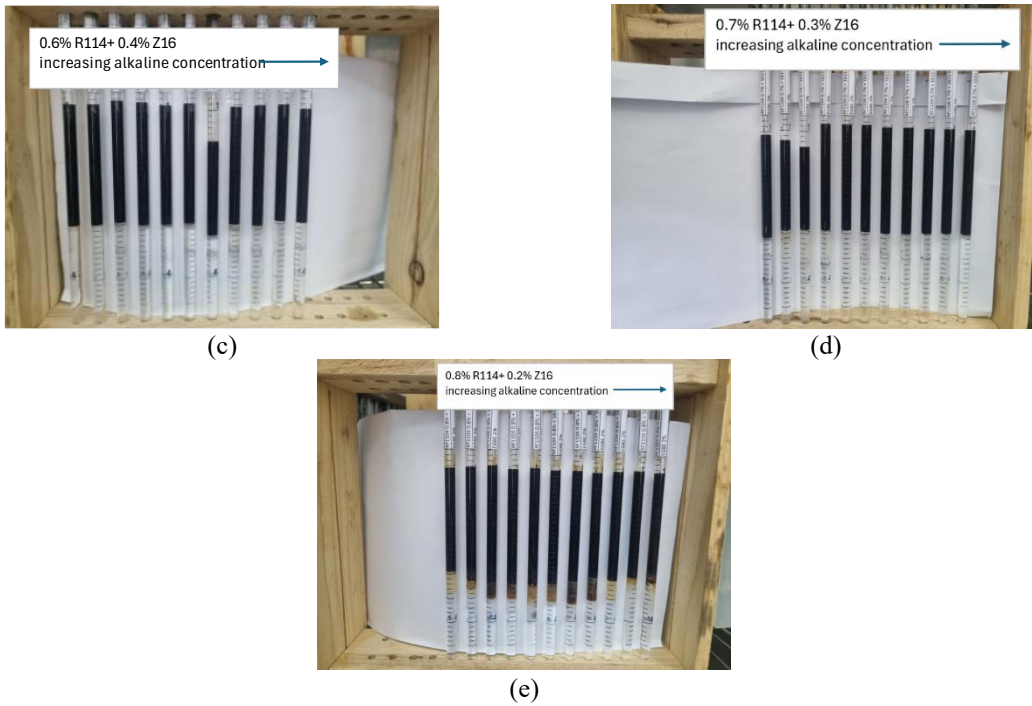
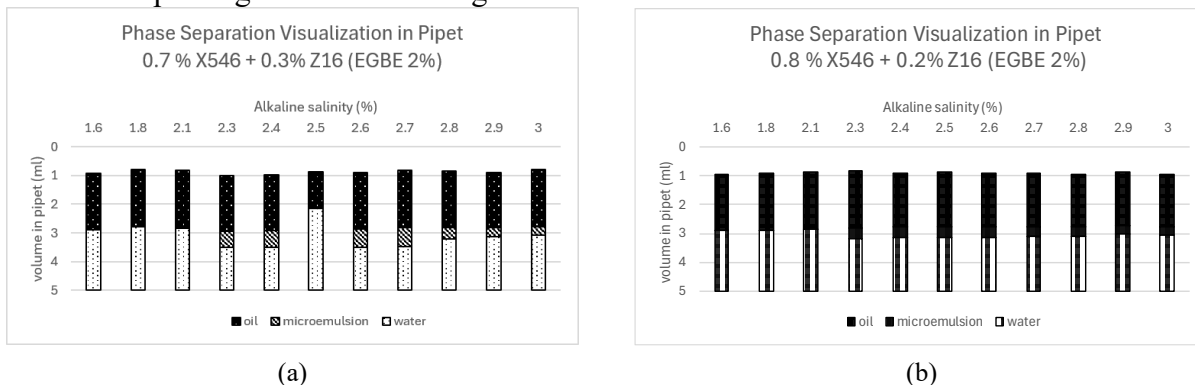


Figure 7. Salinity Scan Result on Seventh Day of 0.6% R113 and 0.4% Z16 (a); 0.7% R113 and 0.3% Z16 (b); 0.6% R114 and 0.4% Z16 (c); 0.7% R114 and 0.3% Z16 (d); and 0.8% R114 and 0.2% Z16 (e)

Surfactant X546 combined with Z16 was able to form Type III microemulsions under certain salinity conditions, with optimum behavior observed at 0.7–0.8% surfactant concentration. In contrast, both R114–Z16 and R113–Z16 systems consistently produced Type II microemulsion. The R114 and R113 formulations required lower salinity conditions that could not be accommodated by the reservoir environment in this study. These findings highlight that while X546 demonstrates potential for achieving balanced oil–brine solubilization, R114 and R113 systems remain constrained to Type II behavior, underscoring the importance of surfactant selection in optimizing microemulsion performance for field deployment.

IFT Estimation

Among the surfactant–cosurfactant combinations tested with standard EGBE concentration, only X546–Z16 produced Type III microemulsions. Accordingly, solubilization ratio plots were generated solely for this system. The plots indicated optimum salinities of 2.65% for 0.7% X546 and 0.3% Z16. Then optimum salinity of 2.6% for 0.8% X546 and 0.2% Z16. In contrast, the 0.6% X546 + 0.4% Z16 formulation, even with EGBE increased to 2.5%, failed to form Type III microemulsions, with the estimated optimum salinity exceeding the 3% limit. This confirms that 0.6% surfactant concentration is insufficient to achieve Type III behavior despite higher EGBE loading.



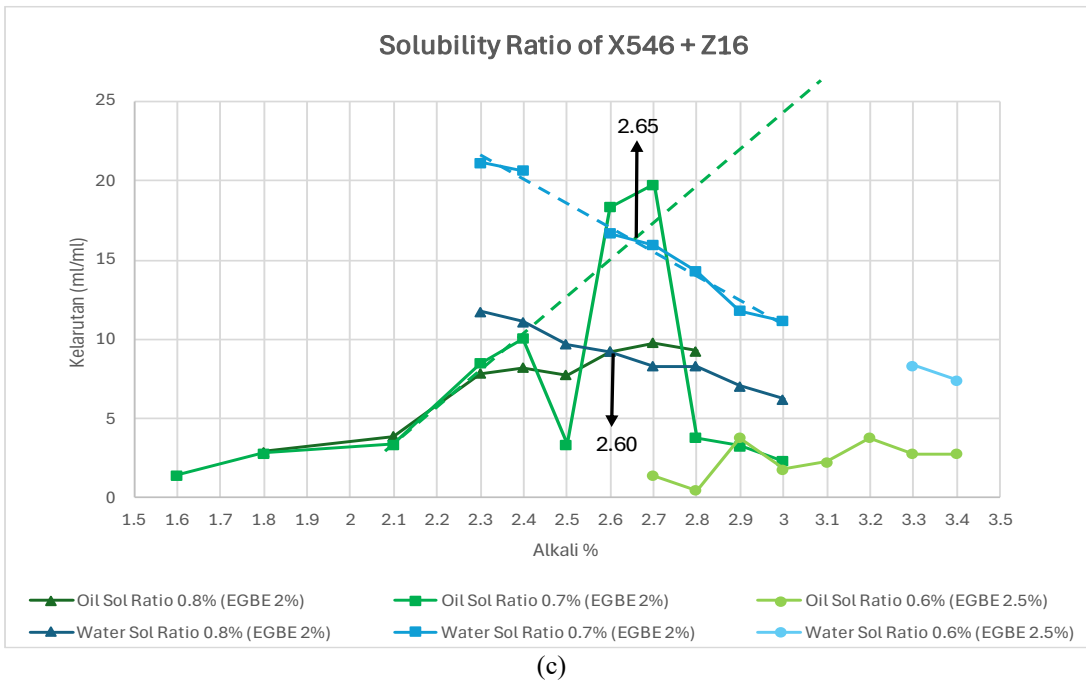


Figure 8. Phase Separation Visualization of 0.7% X546 and 0.3% Z16 (a); Phase Separation Visualization of Solubility Ratio of 0.8% X546 and 0.2% Z16 (b); and Solubility Ratio Plot of X546 and Z16 (c)

For R113 and Z16 and R114 and Z16 systems, solubilization ratio plots were not constructed, as both consistently formed Type II microemulsions dissolving entirely in the oil phase. Their solubilization curves would only reflect oil partitioning without intersection with water solubilization, precluding determination of an optimum salinity. Interfacial tension (IFT) values for the X546 and Z16 that successfully formed microemulsions type III were further estimated using the Huh correlation.

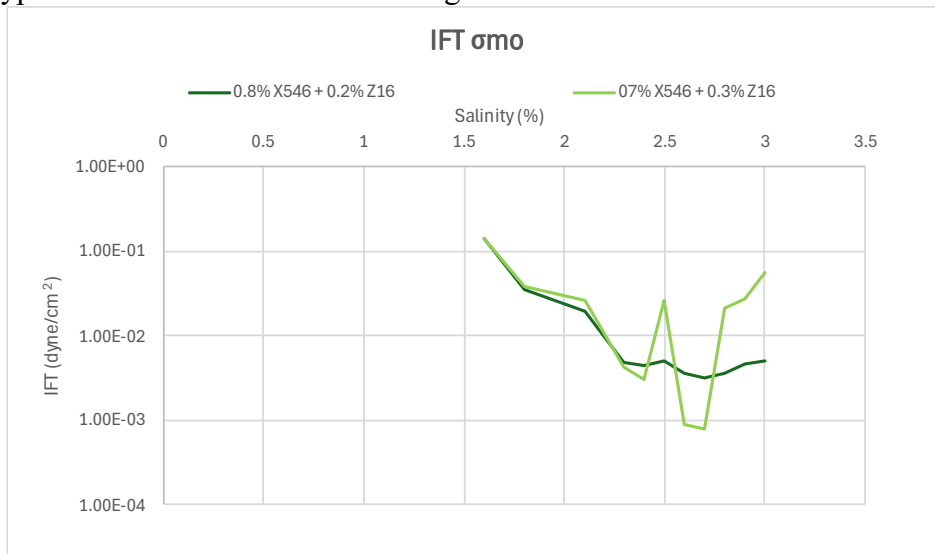


Figure 9. IFT Estimation Using Huh Correlation of X546 and Z16

IFT calculations using the Huh correlation (1979) for the surfactant systems that successfully formed Type III microemulsions showed a progressive decrease in IFT with increasing alkali salinity. At salinity levels corresponding to Type III formation, the estimated IFT values reached ultra-low levels, with value on the order of 10^{-3} . Such ultra-low IFT is critical for enhancing the capillary number, thereby mobilizing residual oil trapped in the reservoir. These findings confirm that the X546–Z16 system not only achieves Type III microemulsion behavior under practical salinity conditions but also provides the interfacial properties necessary to improve displacement efficiency in EOR applications.

CONCLUSIONS

The phase behavior evaluation of alkali–surfactant formulations for CEOR demonstrated that surfactant X546 combined with cosurfactant Z16 successfully formed Winsor Type III microemulsions under reservoir conditions. Optimum performance was achieved at surfactant concentrations of 0.7–0.8 wt.% with salinity windows around 2.6–2.65%, yielding ultra-low interfacial tension values on the order of 10^{-3} dynes/cm. These conditions significantly increased the capillary number, enabling mobilization of residual oil trapped in reservoir pores.

In contrast, formulations with surfactants R113 and R114 consistently produced Type II microemulsions, indicating incompatibility with the reservoir salinity range and limiting their applicability for field deployment. Similarly, X546 combined with cosurfactant Z12 failed to generate Type III microemulsions, reinforcing the importance of surfactant–cosurfactant synergy in achieving balanced oil–brine solubilization.

The application of the Huh correlation to calculate interfacial tension further validated the experimental findings. By linking solubilization ratios to IFT predictions, the correlation consistently indicated values in the ultra-low range (10^{-3}), confirming the reliability of the X546 and Z16 system in achieving the interfacial properties required for effective displacement. This predictive capability strengthens confidence in the laboratory results, as it provides a theoretical framework that aligns with observed phase behavior trends.

Overall, the results confirm that the X546 and Z16 system is the most promising candidate for field-scale application in the studied reservoir. Its ability to form stable Type III microemulsions and achieve ultra-low IFT, supported by both experimental measurements and Huh correlation predictions, highlights its potential to optimize sweep efficiency and enhance oil recovery. Future work should focus on extended coreflood experiments, scale-up testing, and economic feasibility studies to ensure successful implementation in mature waterflooded fields.

Future work should include coreflood experiments to validate the X546 and Z16 system under reservoir conditions and pilot-scale trials to assess performance in heterogeneous environments. Additionally, phase behavior tests of R113 and R114 with cosurfactant Z12 are recommended. While R113 and R114 with Z16 produced Type II microemulsions, Z12 may shift the balance toward Type III. Systematic salinity scans and IFT calculations will clarify this potential and broaden the portfolio of candidate surfactant systems. Finally, integrating the most promising formulations into reservoir simulation workflows will help forecast recovery performance and optimize injection strategies for field deployment.

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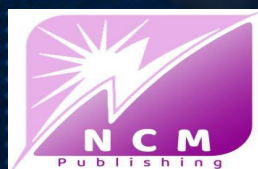
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