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Sentiment of the largest state, first mover, and largest private banks digital performance in Indonesia: Strategic perspective

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Abstract

Digitalization plays an essential role in improving company performance, including banking. Understanding consumer sensitivity in digital banking applications is essential for strategic decisions. This research aims to analyze the user's sensitivity of the largest state, first mover, and largest private bank digital application in Indonesia, using the Naïve Bayes technique through Python. The data were taken from the Google Play Store, a software provider application for computer/laptop and mobile users, with a time range of 3 months from April 2023 until July 2023. The applications as the subject were XAA because it is owned by the largest state-owned bank, namely Bank XA, XBB because it belongs to the first mover for digital banks, and XCC, which is an application from the largest privately owned bank, namely Bank XC. The results reveal that most digital bank application users in Indonesia perceive that existing digital bank applications in Indonesia have yet to be able to meet their expectations. This is explained by the higher average negative value of their feedback answers than the existing positive value. Furthermore, this conclusion was revealed from the finding that XAA and XCC, which still had a positive score, had a higher negative score. Meanwhile, the XBB application, which is a first mover, was found to have a positive value higher than a negative one. We clearly compare the three applications divided into positive and negative categories and discuss the existing negative comments using a Digital Business Capabilities perspective.

Keywords: Digital Banking, Digital Business Capabilities, Sentiment Analysis, Strategic Perspective

1. Introduction

Along with the world's digital transformation, which is developing rapidly, organizations hope to improve their performance by using digital work patterns, especially in companies such as banks, which must operate with fast management and service processes. Digital banking is often seen as a transformation from conventional to online banking. In terms of service performance, changes in people's consumption patterns toward digital have greatly encouraged banks to accelerate the transformation process toward digital banking. Digital transactions worldwide from 2017–2021 grew by 118%, from USD 3.09 trillion in 2017 to USD 6.75 trillion in 2021 (Statista, 2021). Digital transformation has been shown to improve the performance of banks mainly through cost reduction and broader customer reach (Begenau et al., 2018; Chiu & Koeppl, 2019; Fuster et al., 2019; Zhu, 2019). Lee et al. (2021) examined a case within the financial sector as it undergoes paradigm shifts driven by technological advancements, focusing specifically on Deutsche Bank's competitive actions in the rapidly digitizing European banking landscape. The study concluded that Deutsche Bank's innovative initiatives are essential for achieving successful performance in a hyper-competitive environment. Xie & Wang (2023) established an index system to evaluate the digital transformation of banks across three key dimensions: strategic transformation, business transformation, and management transformation. By analyzing the data from Chinese commercial banks, they assessed the progress made in digital transformation within these institutions. Their empirical findings suggest that digital transformation not only improves bank performance but also alleviates the negative impacts of new technological entrants and supports the gradual discontinuation of offline channels.

Fig. 1 shows the trend of Internet and mobile banking transactions in Thailand has grown rapidly in the last 7 years, beating neighboring countries such as Malaysia, Indonesia, and Vietnam. Internet banking is a banking service available through websites or Internet sites. Meanwhile, mobile banking is a banking service available through a smartphone application. Although the way to access them differs, both services require an internet connection and can be used for digital banking transactions, such as bill payments, money transfers, balance checks, etc. In 2015, Thailand's Internet/mobile banking transactions were only 7,786 per 1,000 residents. However, in 2021, the volume increased to 238,245 transactions per 1,000 residents. Cumulatively, the volume of Internet and mobile banking transactions per 1,000 residents in Thailand grew by around 2,959% during 2015–2021. The trend of rapid growth is also seen in Malaysia and Vietnam. During the 2015–2021 period, the volume of internet/mobile banking transactions per 1,000 residents in Malaysia grew by 539%, and in Vietnam, it grew by 1,754%. Meanwhile, the growth rate in Indonesia was only 106% in the same period. As a result, the volume of Internet/mobile banking transactions per 1,000 residents in Indonesia in 2021 will be lower than Malaysia and Thailand and will almost be overtaken by Vietnam, as shown in Fig. 1 (Databoks, 2022).

In Indonesia, the growth of digital transactions has experienced a remarkable acceleration, achieving an impressive increase of 1,556 percent from 2017 to 2020. In 2021, electronic money transactions reached IDR 786.35 trillion. This figure reflects a rise of IDR 281.39 trillion (55.73%) compared to the previous year's total of IDR 504.96 trillion (Detik, 2022). Several banks are very familiar in various circles of society. This digital bank is so loved by millennials in Indonesia today because it is considered very practical and efficient. Users can make transactions and activate accounts online. They can have an account with a device, such as a smartphone, computer, or laptop, connected to the Internet to access digital banking (Fortune, 2022). Recent developments indicate that digital transformation affects commercial banks in two primary ways. The first involves outside-bank digital transformation, which refers to the competitive pressures stemming from non-banking institutions that offer similar digital services. This phenomenon not only intensifies competition but also facilitates technological spillover from fintech companies into banking institutions. A growing body of the literature explores the impact of this outside digital transformation on banks (Guo & Shen, 2016). Second, inside-bank digital transformation pertains to banks' adoption of advanced modern technologies. These technologies encompass artificial intelligence, blockchain, big data, cloud computing, and more (Khattak et al., 2023).

Fig. 2 shows Indonesia's domestic digital banking transactions value reached IDR 4,264.8 trillion, almost IDR 4.3 quadrillion. This includes various transactions like Internet and mobile banking, as defined by the Indonesian Financial Services Authority. According to the regulation issued by the institution, digital banking services are defined as banking services delivered through electronic media, optimized by leveraging customer data. In April 2023, the value of digital banking transactions in Indonesia declined by 11.8% from March 2023 and was 20.1% lower compared to April 2022. However, when we compare it to 5 years prior, the value of digital banking transactions in April 2023 represents a remarkable growth of 158% relative to April 2018. Despite experiencing monthly fluctuations, the long-term trend indicates a strengthening usage of digital banking services in Indonesia, as depicted in Fig. 2 (Databoks, 2023). Banks that invest significantly in technology are viewed as being more digitally transformed. A study by Do et al. (2022) indicates that digital transformation enhances the performance of banks. Theiri & Alareeni (2023) propose that digital transformation can serve as an innovative strategy during crises, such as the COVID-19 pandemic. Given that technology is seen as a cost-effective investment, a positive relationship

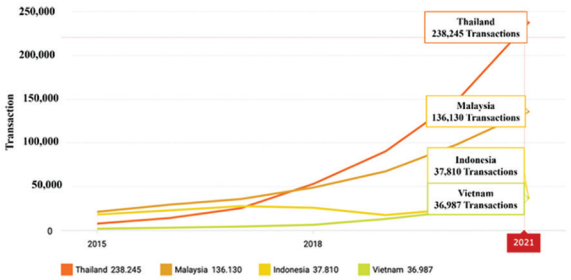


Fig. 1. Internet and mobile banking transaction volume per 1,000 residents in ASEAN countries (2015–2021)
Source: Databoks (2022)

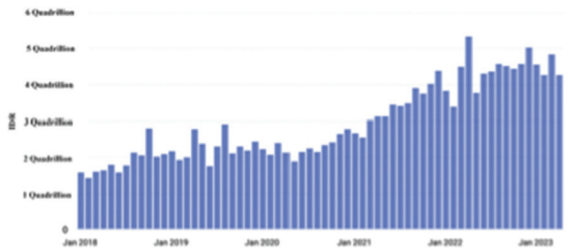


Fig. 2. Indonesia digital banking transactions value per month (January 2018–April 2023)
Source: Databoks (2023)

is anticipated, with digital transformation leading to improved bank stability. Utilizing microdata from Brazil, Silva et al. (2023) discovered that branches of more digitalized banks were less affected by local borrowers' circumstances and were able to broaden their clientele. These branches provided credit to borrowers in remote areas that were less impacted by COVID-19, thereby positioning themselves more favorably compared to their less digitalized counterparts.

Currently, in the aftermath of the COVID-19 pandemic, digital banks in Indonesia are experiencing significant growth, promising enhanced service quality that transcends physical and temporal limitations. The number of banks is on the rise, each offering a variety of digitally focused services. It is important to distinguish between digital banks and conventional banks that merely provide digital services such as mobile and internet banking. Digital banks uniquely enable customers to conduct all banking activities from opening accounts and making transfers to depositing and closing accounts exclusively through smartphones or electronic devices, eliminating the need for physical visits to a bank branch. In addition, a key distinction is that digital banks typically operate without physical branches (aside from a head office) or may have a limited number of physical locations (OJK, 2021a). Conventional banks that offer digital services often struggle to provide all of their offerings online. In addition, these banks are typically associated with numerous physical branch locations. However, there are at least two significant potential benefits that can emerge from the digital transformation of banks. First, it can expand access to banking services. Second, it can enhance the competitiveness of Indonesian banking. Digital banking will facilitate easier public access and improve banking efficiency, ultimately fostering greater economic activity (OJK, 2021b).

The driving factors of digital development can be categorized into three main aspects: digital opportunities, behavior, and transactions. Digital opportunities encompass the influence of demographics, economic conditions, financial potential, internet penetration rates, and the expanding consumer base. Digital behavior pertains to the ownership of devices and the utilization of mobile applications. Digital transactions refer to online trading (e-commerce), digital banking, and electronic money transfers. While the banking industry can capitalize on numerous opportunities presented by digital transformation, it also faces several challenges that require careful consideration. These challenges include the protection of personal data and the risk of data breaches, the possibility that technology investments may not align with business strategies, the misuse of artificial intelligence, cybersecurity threats, outsourcing risks, the necessity to foster readiness within digitally oriented institutional frameworks, ensuring financial inclusion for individuals with disabilities, enhancing digital financial literacy, rapid deployment of information technology (IT) infrastructure, and the need for an appropriate regulatory framework to support (OJK, 2021b). Furthermore, Khattak et al. (2023) discovered that banks experience a positive impact from digital transformation on stability, especially when they maintain a lower level of diversification. As banks diversify further, the advantages of digital transformation start to diminish, potentially turning negative at higher levels of diversification. Their research suggests that increased diversification heightens bank risk in the context of digital transformation, whereas banks with lower levels of diversification benefit from digital transformation, contributing to greater stability.

2. Literature Review

2.1. Digital Banking

Numerous studies indicate a need for further research into strategic decisions concerning the use of digital banking products, particularly in comparison to the existing studies on the service quality of these digital offerings. Hoehle et al. (2012) explored digital banking utilization and noted limitations in previous research due to the phenomena studied and the methodologies employed. Waite & Harrison (2015) advocate for alternative research perspectives to examine digital banking, while Piyathasanan et al. (2015) point out the scarcity of experiential guidelines in this domain. It is essential for banks to leverage digital banking to enhance customer benefits (Patsiotis et al., 2012). The scope of digital banking encompasses electronic banking services accessed via digital devices, including t-banking, e-banking, mobile banking, contactless cards (such as tap-and-go), ATMs, and point-of-sale systems, while excluding platforms like PayPal that serve as intermediaries (e.g., eBay) for banking transactions. These studies imply that banks can enhance customer experience and overall performance by utilizing digital banking channels. Therefore, the impact of digital banking requires clarification (Mbama et al., 2018). Some ways are by detecting consumer satisfaction based on what they feel as users of digital applications.

2.2. Performance versus Perceived Performance

Digital banking has empowered banks to enhance customer satisfaction by providing instant services through various distribution channels (Tam & Oliveira, 2017). As customer expectations continue to rise, firms are compelled to adopt a more

customer-centric approach and invest in delivering quality services, improving performance (Pekovic & Rolland, 2016), and strengthening their brand image (Fritz et al., 2017). The study by Julien & Tsoni (2013) focuses on the perceptions of banking staff and customers, aiming to identify gaps in perception and enhance the co-production of service quality. In recent years, mobile banking (m-banking) has emerged as a significant strategic shift for banks (Tam & Oliveira, 2017). Perceived performance reflects customers' views on service attributes, benefits, and overall outcomes (Rahi et al., 2023; Venkatesh et al., 2003). So far, studies have only measured the quality of digital banking product services by detecting user satisfaction based on their feelings. As stated by Eren (2021), satisfaction serves as the basis for user behavior and can be evaluated by examining the confirmation or disconfirmation of user expectations alongside the performance of the service. Customer expectation refers to the perceptions customers have about what they anticipate receiving in exchange for utilizing a service (Franque et al., 2021; Rahi et al., 2023; Venkatesh et al., 2003). However, this method must, of course, be seen from two sides. After dissecting the customer's perspective, it is necessary to study the strategic perspective to see possible future performance.

Additionally, research into user responses to technology services like artificial intelligence (AI) indicates that users experience either confirmation or disconfirmation of their expectations when using AI-enabled banking. When user expectations align with their needs and enhance customer satisfaction, the experience is positive. However, if expectations are not met, it can lead to negative attitudes toward AI-based banking (Azizi et al., 2021; Bhattacherjee, 2001; Bastari et al., 2020). Positive confirmation enhances perceived performance, which in turn leads to greater user satisfaction and a stronger acceptance of artificial intelligence (Al-Okaily, 2024; Brill et al., 2019). Previous research has employed expectation confirmation theory as a framework to explore how users' expectations of technology services are confirmed or disconfirmed. This theory has been instrumental in examining the relationship between users' satisfaction and the perceived usefulness of these services, shedding light on how initial anticipations influence overall user experience and acceptance of technology (Bhattacherjee, 2001; Brill et al., 2019; Eren, 2021; Kim, 2018; Kosiba et al., 2020).

2.3. Digital Business Capability (DBC)

DBC is an essential aspect for organizations that aim to thrive in the competitive landscape shaped by rapid technological advancements (Stocker et al., 2024). This capability empowers companies to quickly and effectively respond to shifting market dynamics and the diverse demands of today's consumers. By harnessing DBC, organizations can streamline their operations, optimizing workflows to enhance efficiency and productivity while simultaneously fostering a culture of innovation. This ultimately leads to the development and delivery of cutting-edge products and services that resonate with their target audience (Hall et al., 2020). Moreover, the process of digital transformation not only paves the way for reduced operational costs and increased revenue streams but also plays a pivotal role in elevating the overall customer experience. It cultivates an environment of collaboration within teams, enabling them to work together more seamlessly to meet shared goals (Balakrishnan & Das, 2020; Meena et al., 2024). Wielgos et al. (2021) found that DBC is more valuable for business-to-consumer than for business-to-business firms and revealed that DBC is more valuable under high than low levels of structural flux. Exciting insights are presented by Khattak et al. (2023), highlighting that investments in technology and increased diversification can render banks riskier and more vulnerable. Li et al. (2018) examined small and medium enterprises that lack adequate capabilities and resources, concluding that managerial capabilities are the primary catalyst for digital transformation. Vial (2019) underscored the significance of IT capabilities, arguing that they enhance firm performance, with digital transformation initiatives serving as a mediating factor.

DBC is a multifaceted construct that comprises three interrelated components: (i) Digital strategy (DS), (ii) digital integration, and (iii) digital control, as articulated by various scholars (Ranjan, 2024; Sorescu & Schreier, 2021; Wielgos et al., 2021; Xia et al., 2024). The first component, DS, plays a pivotal role in defining and articulating distinct objectives and goals aimed at harnessing the power of digital technologies to propel business success. This strategic approach not only involves a thorough comprehension of the ever-changing market dynamics but also requires a deep awareness of customer needs, ensuring harmony with the organization's broader business strategies (Bresciani et al., 2021; Henderson & Venkatraman, 1999; Gobble, 2018; Guinan et al., 2019; Warner & Wäger, 2019; Yeow et al., 2018; Zaki, 2019). Moreover, this process necessitates the effective implementation of various digital technologies across different layers of an organization, accompanied by a commitment to ongoing monitoring and adaptation of these strategies to sustain a competitive edge within the marketplace (Warner & Wäger, 2019). The significance of a well-defined DS cannot be overstated; it is essential not merely for maintaining competitiveness but also for

fostering long-term growth and innovation (Tardieu et al., 2020). Importantly, DS is not a singular, isolated endeavor but rather a continuous process that demands regular evaluation and refined adjustments to respond to evolving market conditions and technological advancements (Chirumalla, 2021; Grover & Malhotra, 1997; Guinan et al., 2019; Szelągowski & Berniak-Woźny, 2022).

Digital integration emphasizes the comprehensive implementation of various strategies that permeate every facet of an organization, encompassing areas such as marketing, operations, and beyond (Berman, 2012; Chaffey & Smith, 2022; Gunasekaran & Ngai, 2004; Holopainen et al., 2022; Leeflang et al., 2014; Yeow et al., 2018). In today's dynamic and constantly evolving business landscape, it is imperative for organizations to cultivate agility and responsiveness. By seamlessly weaving digital technologies into all operational segments, businesses can achieve greater efficiency, streamline workflows, and significantly enhance the overall customer experience (Zaki, 2019). This holistic approach not only positions companies favorably within their competitive landscape but also empowers them to swiftly adapt to emerging market trends and consumer demands (Knudsen et al., 2021).

Digital control encompasses the processes of closely monitoring and adjusting various strategic initiatives to ensure their effectiveness in driving desired outcomes (Liu et al., 2009; Nylén & Holmström, 2015; Proia et al., 2022). In the face of today's rapidly changing business landscape, companies must cultivate mastery over three essential capabilities to flourish in the digital era. By consistently analyzing the data and assessing performance metrics, organizations are empowered to make well-informed decisions and adapt their strategies as circumstances evolve (Bajwa et al., 2017; Kirtley & O'Mahony, 2023; Kokina et al., 2017). This proactive methodology toward digital control allows businesses to maintain agility and swiftly respond to fluctuating market conditions, ensuring they remain competitive and relevant (Berman & Marshall, 2014; Giacosa et al., 2022; Gunasekaran & Yusuf, 2002; Yeow et al., 2018).

As technology evolves at an astonishing rate, companies must prioritize digital integration and control to stay competitive and fulfill the changing demands of their customers (Berman & Marshall, 2014; Giacosa et al., 2022; Gunasekaran & Yusuf, 2002; Yeow et al., 2018). However, having access to data and metrics alone does not guarantee success. Even organizations that make substantial investments in data analysis and performance tracking can struggle to effectively utilize these insights, resulting in poor decision-making and ultimately impeding their ability to thrive in the digital landscape (Dahlbom et al., 2020). Success is not solely dependent on having the right technology; it equally requires cultivating the expertise and strategic vision needed to leverage these tools effectively (Henderson & Venkatraman, 1999; Luftman et al., 1993; Quinn et al., 1999. Without the capability to effectively harness insights from data analysis, organizations risk falling behind in an increasingly competitive market (Ranjan & Foropon, 2021; Sharma et al., 2014; Wang et al., 2018).

2.4. Research Questions (RQ)

The discussions above reveal the importance of looking at the user's perspective as the basis for a strategy to improve banking digitalization performance. The author tries to comprehensively analyze this perspective in this case. The RQ are:

1. RQ1: What are the sentiment analysis results for the three banking applications analyzed in Indonesia?
2. RQ2: How can banks improve their digital business capabilities to satisfy customers?

3. Method, Data, and Analysis

This research used the subject of Digital Banks in Indonesia in 2023. The selected digital banks are three digital banks from different classifications, and the basis is the application, which is currently still developing, namely:

(i) XAA is a digital banking application from the largest state-owned bank in Indonesia
(ii) XBB is a digital banking application from Bank XB and is a first-mover application in digital banking
(iii) XCC is a digital banking application from the largest privately owned bank in Indonesia.

The respondents were Indonesian people who commented on the Google Play Store. Data is pulled from Google Play Store using a Python application with the Naïve Bayes technique. Naïve Bayes is a classification algorithm based on Bayes' theorem, assuming conditional independence between features, which is why it is considered "naïve" (Allam et al., 2025). Despite rarely meeting this assumption in real data, it has proven effective in tasks like document categorization, spam filtering, and sentiment analysis (Mendhakar & Tilmatine, 2023). This research employs a Multinomial Naïve Bayes, which models word frequency per class and works well with word counts (Ridho et al., 2022; Zhang, 2004). The text is represented using the Bag-of-Words model, where documents are collections of words with their frequency. Features can include unigrams or n-grams, though overly long n-grams may reduce accuracy (Nandwani & Verma, 2021). To enhance feature

quality, weighting schemes like term frequency-inverse document frequency are used to emphasize unique words within documents, aiding Naïve Bayes in identifying important keywords (Allam et al., 2025). In this research, data are collected from the Google Play Store using the google_play_scraper library in Python. User ratings classify comments for digital banking applications: ratings of 1 and 2 indicate negative sentiments, while ratings of 4 and 5 represent positive sentiments; ratings of 3 are considered neutral and ignored. Preprocessing is conducted to enhance data quality, involving steps such as: Handling missing values by removing incomplete entries, tokenization for breaking text into manageable word units, removing stop-words that carry little significance in sentiment analysis, and lemmatization to normalize words to their base forms. A Multinomial Naïve Bayes model is then employed for sentiment classification, trained on the processed data, and evaluated using metrics like f1-score, precision, and recall. The model was built using a dataset split of 80:20 for training and testing. The implementation leverages the "MultinomialNB" classifier from "sklearn.naive_bayes," with default hyperparameters maintained, including an alpha of 1.0 for Laplace smoothing. The model predicts sentiment based on the review text, assessing user perception of the digital banking application.

Furthermore, this study's first assessment (RQ1) was carried out using sentiment analysis, which looks at public opinion about digital banks. The data are in the text form, which is an opinion expressed in Indonesian. The sample taken is data for 3 months, from April 2023 until July 2023; the data found are a total of 3000 data, which for XAA is 1,000 Data, XBB 1,000 Data, and XCC 1,000 Data. The analysis will divide user perspectives into positive and negative categories for the three applications studied. The result is aggregate data for comparative analysis. After answering RQ1, the second assessment of this study (RQ2) is conducted through a DBC perspective (Ranjan, 2024; Sorescu & Schreier, 2021; Wielgos et al., 2021; Yi et al., 2024). Discussion on the DBC perspective is deemed necessary to fulfill the perspective within existing application capabilities. A slight difference from the DBC survey, which uses indicators for surveying, DBC in this study was studied based on negative comments from application users. Positive reviews have their aspects, which are not discussed in this study. We deem the selection of negative aspects necessary because the comments made by users are direct and occur spontaneously of their own accord, so they are deemed necessary to study. In contrast to particular survey results where the scale has been determined, and there is a need to accommodate the surveyor's request to fill out a questionnaire or answer interview questions, spontaneous results in the Google Play Store application are seen as the user's desire to provide comments naturally (their desires and needs for themselves) so that the response to negative comments is also seen as very honest and has a critical weight to respond to.

The existing negative comments are related to DBC descriptively, namely the researcher's considerations through indicators, namely DS, Integration (DI), and Control (DC). For the DS, the perspective used is the extent to which the DS creates new opportunities to add value for our customers (DS1), add value for the firm and its partners (DS2), and continuously deliver innovations in digital products and services (DS3). For digital integration, the perspective used is the extent to which the firm is becoming more connected online with customers, suppliers, and partners (DI1). Digital business transformation is becoming integral and interconnected across all areas of the company (DI2), digital skills are transforming business processes within firms (DI3), business processes across the value chain are becoming more digitally interconnected (DI4), and, the firm is becoming more interconnected through digital platforms (DI5). Meanwhile, for Digital Control, the perspective used is the extent to which the firm has clear specifications for implementing digital business transformation (DC1), the firm consistently tracks its digital business transformation progress (DC2), and the firm regularly analyzes performance metrics to evaluate its digital business transformation (DC3). The comment data generated from Google Play Store are summarized and analyzed descriptively so that comments that tend to be the same will be combined into one (representative) so that it appears there are only a few comments. These results become material for this study's findings based on the DBC.

4. Result and Discussion

4.1. Data Description

A data description is needed to see the statistical value. Fig. 3 shows the result for XAA.

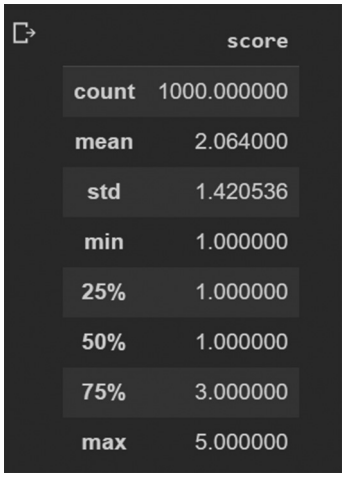
The XAA data obtained are 1,000, with a minimum value of 1.0, namely, a polarity value of strong negative and a max value of 5.0 with a strong positive polarity. However, if we look at the mean owned by XAA, which is in the range of 2.06, it can be interpreted that the comments owned by XAA are in negative territory.

Next, Fig. 4 shows the data description for XBB.

XBB has a total of 1,000 data, with a minimum value of 1.0, which indicates the polarity or intensity of the most negative response is a strong negative, and the max value is 5.0, which indicates a strong positive polarity of sentiment, with a mean of 3.62 or rounding off 4 concludes that the comments that are owned by genius are in positive territory.

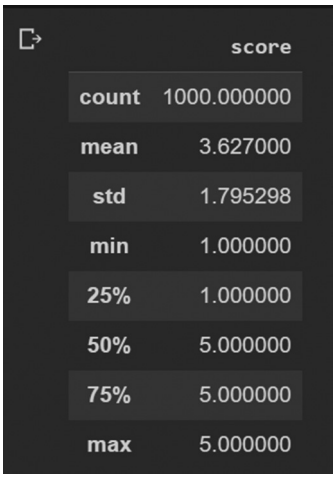
Furthermore, Fig. 5 shows the data description for XCC.

XCC has 1000 data, with min is 1.0, so the polarity is negative, and max is 5.0, so the polarity is strongly positive. XCC's mean value is 2.6, which is in the negative to neutral quadrant.



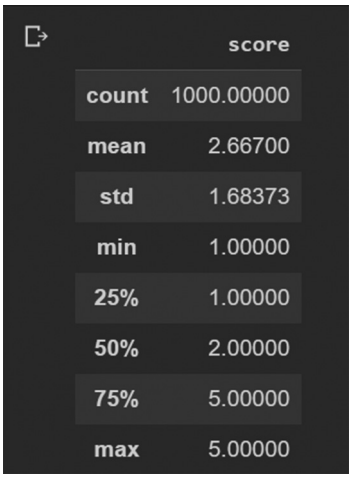
	score
count	1000.000000
mean	2.064000
std	1.420536
min	1.000000
25%	1.000000
50%	1.000000
75%	3.000000
max	5.000000

Fig. 3. XAA data description



	score
count	1000.000000
mean	3.627000
std	1.795298
min	1.000000
25%	1.000000
50%	5.000000
75%	5.000000
max	5.000000

Fig. 4. XBB data description



	score
count	1000.00000
mean	2.66700
std	1.68373
min	1.00000
25%	1.00000
50%	2.00000
75%	5.00000
max	5.00000

Fig. 5. XCC data description

4.2. Model Validity

The Naïve Bayes model applied in this study shows fairly high performance, with the following accuracy rates: XAA: 91%, XBB: 92%, and XCC: 88%. To ensure a more comprehensive evaluation, the model was analyzed using the f1-score metric, which is the harmonic mean between precision and recall. The evaluation results show that the model performs well in distinguishing between positive and negative sentiments:

- XAA: Negative (0.95) and positive (0.69)
- XBB: Positive (0.94) and negative (0.88)
- XCC: Negative (0.89) and positive (0.85).

Data are considered valid if it achieves an f1-Score >0.7 (Allam et al., 2025; Nandwani & Verma, 2021). In the data collected for this study, most classes exhibit an f1-score above this threshold. However, the positive class XAA has an F1 Score of <0.01 (0.69). Despite this, it is still regarded as having substantial validity (Allam et al., 2025). Therefore, the model can be classified as robust and capable of effectively explaining the findings.

4.3. Multinomial Naïve Bayes

The Naïve Bayes algorithm is a machine learning algorithm for classification based on the Bayesian theorem. This algorithm studies the probability of an object with specific characteristics belonging to a particular class or group. This method is often used to solve opinion-mining problems. In this sentiment analysis research, the approach used is Multinomial Naïve Bayes, a model that calculates the frequency of occurrence of words from a document (Zhang, 2004). Hence, the results obtained per application are as follows.

The results for the XAA application state the same thing as the results in Table 1: the majority of independent reviews are in the negative category. The value that becomes the benchmark is the f1 score because the f1 score is the harmonic average value of precision and recall. The picture above reveals that a negative f1 score of 0.95 is greater than a positive f1 score (0.69) with an accuracy rate of 91%.

The results obtained from the multinomial Naïve Bayes are the same as those in Table 2, which states that genius is in the positive category. If we look at the f1 score obtained, the positive result for genius (0.94) is greater than the negative result for genius (0.88), with an accuracy of 92%. The value that becomes the benchmark is the f1 score.

Table 1. XAA result

Item Analyzed	Prec.	Recall	f1	Support
Negative	0.90	1.00	0.95	143
Positive	1.00	0.53	0.69	34
Accuracy			0.91	177
Macro avg	0.95	0.76	0.82	177
Weighted avg	0.92	0.91	0.90	177

Table 2. XBB result

Item Analyzed	Prec.	Recall	F1	Support
Negative	0.80	0.98	0.88	57
Positive	0.99	0.90	0.94	135
Accuracy			0.92	192
Macro avg	0.90	0.94	0.91	192
Weighted avg	0.93	0.92	0.92	192

The data in Table 3 states that the f1 score obtained is a negative value (0.89), slightly higher than a positive value (0.85), with an accuracy of 88%. The multinomial results have the same results as the XCC data description results, where these results state that there is very little difference between positive and negative comments. So, the comparison of negative feedback between XAA, XBB, and XCC is more clearly presented in Fig. 6.

Meanwhile, the comparison of the positive feedback is shown in Fig. 7.

RQ1: In general, it shows that of the three banks, the XAA application is in a strongly negative category, while XBB has a positive category. Moreover, if XCC is included even though it is positive, it reveals that XCC is still in the neutral to positive category. This confirms the results obtained in the previous data description, with XBB mean of 3.62 to 4, which has reviews that tend to be positive; XCC has a mean of 2.66 toward three (toward neutral). It explains that XCC's positive and negative reviews are slightly balanced, and the Mean XAA value of 2.06 states that the review owned by XAA is in the negative category. However, the average comparison of positive (0.83) and negative (0.91) reviews concludes that currently, the majority of users in Indonesia still view digital bank applications as needed to meet user expectations. Satisfaction is influenced by several factors, including expectation confirmation, perceived performance, trendiness, visual attractiveness, problem-solving capabilities, customization, and communication quality. These elements reveal a significant variance of $R^2 = 51.1\%$ in digital banking user satisfaction (Alnaser et al., 2023). The integration of artificial intelligence features such as trendiness, visual appeal, and problem-solving has enhanced the attractiveness, appeal, and innovativeness of banking operations. For instance

Table 3. XCC result

Item Analyzed	Prec.	Recall	F1	Support
Negative	0.90	0.88	0.89	104
Positive	0.84	0.86	0.85	72
Accuracy			0.88	176
Macro avg	0.87	0.87	0.87	176
Weighted avg	0.88	0.88	0.88	176

Fig. 6. Negative feedback comparison

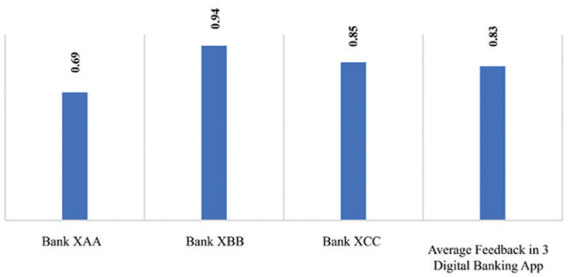


Fig. 7. Positive feedback comparison

(Chung et al., 2020) noted that customers tend to favor trendy services over traditional options. Additionally, there has been a significant shift in the business landscape, as the role of salespersons has diminished; customers now increasingly rely on online systems to enhance their lifestyles (Godey et al., 2016). Previous research has demonstrated that artificial intelligence-driven digital banking aligns well with customers' needs and contemporary lifestyles, ultimately leading to increased user satisfaction (Chung et al., 2020; Godey et al., 2016; Zolkepli & Kamarulzaman., 2015). Aside from trendiness, digital banking services should be attractive and appealing (Bhandari et al., 2019; Gupta et al., 2023; Ho et al., 2023).

4.4. Negative Comments

(1) XAA Perceived Performance

Analyzed data summarized several negative reviews. Of the 100 negative reviews, there were reviews as representations of the XAA application. The first problem that occurred with the XAA application was:

- Every time a transaction is made, the application is asked to update the clock automatically; this is a problem that disrupts banking activities; the majority of reviews give 1 star (worst) for the problem of updating automatic hours.
- When the transfer activity is needed, there are always problems with the network, and the most frequent complaint is the notification of "transfer failed, connection error, please check your connection and try again."
    - These two things are the main problems that application providers must address regarding digital solutions. From the DBC perspective, these two problems we consider lie in the dimensions of DS, Integration, and Control. The application provider has yet to be able to meet two indicators in the DS dimension. Namely, the provider's DS has not been able to create value for customers (DS1) and has yet to be fully able to continuously deliver innovations in digital products and services (DS3). For the Digital Integration dimension, what directly impacts these comments is the indicator that the firm is becoming more connected online with customers, suppliers, and partners (DI1). Meanwhile, this problem is related to the overall indicators in the Digital Control dimension; namely, the firm has clear specifications for implementing digital business transformation (DC1); the firm consistently tracks its digital business transformation progress (DC2), and the firm regularly analyzes performance metrics to evaluate its digital business transformation (DC3).

(2) XBB Perceived Performance

The result reveals that there were still some negative comments about the performance of the XBB application. The negative comments received on the XBB application tend to be in the direction of:

- Difficulty in registration: Almost all complained in video calls about data verification.
- Unlinking the device cannot be done via the application but via customer service via telephone.
- There is no cost transparency or detailed cost explanations by the genius team in the field, so there are many hidden fees that users do not know about
    - These three things are the main problems that application providers must address regarding digital solutions. From the DBC perspective, these problems lie in the dimensions of DS, integration, and control. The application provider has yet to be able to meet two indicators in the DS dimension; the provider's DS has not been able to create value for customers (DS1) and has not been able to continuously deliver innovations in digital products and services (DS3). Meanwhile, in the digital Integration dimension, the provider has yet to make the business processes across the value chain more digitally interconnected (DI4). So for the Control Dimension, this problem is related to the overall indicators; namely, the firm has clear specifications for implementing digital business transformation (DC1), the firm consistently tracks its digital business transformation progress (DC2), and the firm regularly analyzes performance metrics to evaluate its digital business transformation (DC3). These facts explain that in general existing business processes have not been able to optimally meet user needs, namely that the digital transformation has not answered the need for service flexibility and cost transparency.

(3) XCC Perceived Performance

The result proves that there are negative reviews that users often discuss. This review only focuses on two things, namely:

- Difficulty in "signing in" the application
- Difficulty in verifying personal data.
    - These two things are the main problems that application providers must address regarding digital solutions. From the DBC perspective, we consider that this problem lies in the three existing dimensions: DS, Integration, and Control. Application providers have yet to be able to meet two indicators in the DS dimension. Namely, the provider's DS has not been able to create value for customers (DS1) and has not been able to continuously deliver innovations in digital products and services (DS3). Meanwhile, in the digital Integration dimension, the provider has yet to make the business processes across the value chain more digitally interconnected (DI4). So for the Control Dimension, this problem is related to the overall indicators; namely, the firm has clear specifications for implementing digital business transformation (DC1), the firm consistently tracks its digital business transformation progress (DC2), and the firm regularly

analyzes performance metrics to evaluate its digital business transformation (DC3). This means that the company still needs to implement these control indicators fully.

4.5. Discussion

The results show that (RQ1) of the three banks, the XAA application is strongly negative, while XBB has a positive category. Moreover, if XCC is included even though it is positive, it reveals that XCC is still in the neutral to positive category. XBB reviews tend to be positive; XCC's positive and negative reviews are slightly balanced, and the XAA reviews tend to be negative. However, the average comparison of positive (0.83) and negative (0.91) reviews reveals that the majority of users in Indonesia still view digital bank applications as not being able to meet user expectations. Theoretically, measurement via DBC is relevant to the development of banking digitalization in Indonesia. The negative reviews show similarities between the three applications regarding DBC indicators, namely DS1, DS3, DI4, DC1, DC2, and DC3. This finding explains that negative comments on Google Playstore lead to the same needs for these indicators, while other indicators on DBC receive a portion outside of negative comments. Thus, the results obtained that still require encouragement by banking digitalization practitioners to transform their digital banking applications are:

1. Create the value of "convenience and fast service" (DS1), and continue to deliver digital products and service innovations (DS3). These factors can be enhanced by leveraging the insights gained from data analysis, and organizations can customize their digital services to better meet the needs of their target audience, ultimately leading to increased customer satisfaction and loyalty. In today's digital age, the ability to effectively harness data is essential for organizations to not only survive but thrive in a competitive market (Amankwah-Amoah & Adomako, 2019; Grover et al., 2018; Oppong et al., 2005; Sultana et al., 2022). Companies that effectively implement digital strategies are able to adapt to changing market conditions and customer preferences, ultimately leading to increased revenue and market share (Katsikeas et al., 2020; Leeflang et al., 2014; Zaki, 2019). By investing in digital technologies and staying ahead of the curve, businesses can secure their position as industry leaders and continue to drive growth in the long term.
2. Become more connected online with customers, suppliers, and partners (DI1). The disrupted distribution (usage) value chain for customers must be repaired. It is in order to adapt and stay relevant in an ever-changing landscape. This corrective action can be achieved by continuously analyzing and interpreting data to understand customer behavior and preferences, allowing organizations to make informed decisions and deliver personalized experiences (Chakravarty, 2014; Cordon et al., 2016; Roden et al., 2017). By addressing these disruptions and staying ahead of the curve, organizations can ensure long-term success and sustainable growth in the digital marketplace. Ultimately, successful digital integration can lead to increased revenue, growth, and long-term sustainability in today's competitive landscape (Knudsen et al., 2021). It can lead to increased revenue, growth, and long-term sustainability in today's competitive landscape, giving companies a significant advantage over their competitors (Bereznoy, 2019).
3. Concrete specifications for implementing digital business transformation (DC1), regularly track its digital business transformation progress (DC2), and regularly analyze performance metrics to evaluate its digital business transformation (DC3). These factors require the right staff to control the transformations. This will help ensure that organizations can adapt quickly to change and remain competitive (Holbeche, 2007; Prastacos et al., 2002). Additionally, implementing regular training programs for employees can help them stay up-to-date on the latest technologies and trends in the industry (Kamble et al., 2018; Tavitiyaman et al., 2022; Vashishth et al., 2024). By fostering a culture of innovation and adaptability, organizations can create a dynamic and agile workforce that is able to respond effectively to any disruptions in the market (Ajgaonkar et al., 2022; Dyer & Shafer, 2003; Ulrich & Yeung, 2019. With the right tools, resources, and team in place, organizations can position themselves as leaders in their respective industries and thrive in the digital age. It is also crucial for organizations to invest in ongoing training and development programs to keep their workforce up-to-date with the latest advancements in technology and industry best practices (Dachner et al., 2021; Gope et al., 2018; Sonnentag et al., 2004). Additionally, fostering a culture of collaboration and open communication can help employees feel empowered to share innovative ideas and solutions (Ahsan, 2024; Barczak et al., 2010; Çakar & Ertürk, 2010; Islam et al., 2024; Lemon & Sahota, 2004; Jaskyte, 2004); Lin, 2007; Waseel et al., 2023). With a strong foundation of adaptability, innovation, and a skilled workforce,

Table 4. Digital improvement solution matrix

Commented Problem / Indicator Related	XAA • Every time a transaction is made, the application is asked to update the clock automatically; this is a problem that disrupts banking activities; the majority of reviews give 1-star (worst) for the problem of updating automatic hours. • The "transfer failed, connection error, please check your connection and try again".	XBB • Difficulty in registration: Almost all complained in video calls about data verification. • Unlinking the device cannot be done via the application but via customer service via telephone. • There is no cost transparency or detailed cost explanations, many hidden fees that users do not know about	XCC • Difficulty in "signing in" the application • Difficulty in verifying personal data.
The firm digital strategy creates value for customers (DS1)	Creating the value of "convenience and fast service" with Total Quality Management (TQM) related to the efficiency of updating clocks, and preventing transfer failures due to the network. This value can open up other new opportunities to provide greater value to customers.	Creating the value of "convenience, fast service, and accurate information dissemination" with TQM related to the registration process, efficient device unlinking process for customers, and cost transparency. This value can open up other new opportunities to provide greater value to customers.	Creating the value of "convenience and fast service," with TQM related to the ease of the "sign in" process, and the efficiency of the personal data verification process. This value can open up other opportunities to provide greater customer value.
The firm continuously delivers innovations in digital products and services (DS3)	Continue to provide digital services by expanding/enlarging the benefits and appeal and providing appropriate usage methods for customers.	Continue to provide digital services by expanding/ enlarging the benefits and appeal and providing appropriate usage methods for customers.	Continue to provide digital services by expanding/enlarging the benefits and appeal and providing appropriate usage methods for customers.
The firm business processes across the value chain are becoming more digitally interconnected (DI4)	The disrupted distribution (usage) value chain for customers must be repaired, namely the system clock update system and transfer failures due to network disruptions, so that it does not disrupt components others in the value chain	The disrupted distribution (usage) value chain for customers must be repaired, namely registration barriers, inefficient processes for unlinking the device, and decreased customer trust due to hidden costs.	The disrupted distribution (usage) value chain for customers must be repaired, namely obstacles to the "sign-in" process and inefficient data verification processes.
The firm has clear specifications for implementing digital business transformation (DC1)	Specifications that are not yet concrete must be refined, namely the Standard Operation Procedure (SOP) for preventing errors during the service process, and the SOP for maintaining the network when digital banking transactions occur.	Specifications that are not yet concrete must be refined regarding efficient registration SOPs, appropriate SOPs for unlinking the device, and appropriate SOPs regarding cost disclosure.	Specifications that are not yet concrete must be refined regarding the SOP for the "sign-in" service to eliminate obstacles, and the SOP for the personal data verification process is appropriate and makes it easier for consumers.
The firm consistently tracks its digital business transformation progress (DC2)	The transformation monitoring system must be more stringent. Place the right staff to control it.	The transformation monitoring system must be more stringent. Place the right staff to control it.	The transformation monitoring system must be more stringent. Place the right staff to control it.
The firm regularly analyzes performance metrics to evaluate its digital business transformation (DC3)	Transformation performance metrics must continue to be analyzed accurately. Place the right staff to maintain the accuracy.	Transformation performance metrics must continue to be analyzed accurately. Place the right staff to maintain the accuracy.	Transformation performance metrics must continue to be analyzed accurately. Place the right staff to maintain the accuracy.

organizations can stay ahead of the curve and remain competitive in the fast-paced digital age.

4.6. Managerial Implication

Furthermore, to answer RQ2, we formulated a matrix that analyzes the findings of negative comments based on the affected DBC indicators and recommends practical solutions for parties involved in application transformation in digital banking in Indonesia, which is shown in Table 4.

The digital improvement solution matrix above explains how the next treatment for XAA, XBB, and XCC applications should be. However, of course, a transformation will be realized well if the existing management is also able to do it. Li et al. (2018) stated that managerial capabilities are the main driving force for digital transformation. Indeed, digital banking should have enabled banks to delight customers with instant services through distribution channels (Tam & Oliveira, 2017). Thus, this study has confirmed user expectations and strengthened them with digital improvements based on DBC theory and other theoretical supports as predictors of the success of XAA, XBB, and XCC.

5. Conclusion and Suggestion

The results reveal that most digital bank application users in Indonesia perceive that existing digital bank applications in Indonesia have yet to be able to meet their expectations. This is explained by the higher average negative value of their feedback answers than the existing positive value. Furthermore, this conclusion was revealed from the finding that XAA and XCC, which still had a negative score, had a higher positive score. Meanwhile, the XBB application, which is a first mover, was found to have a positive value higher than a negative one. This perceived performance view is a benchmark for the performance of digital banks in Indonesia to continue to develop their effectiveness and efficiency in managing service applications in direct contact with their users. The uniqueness of this research is that it uses three selected digital applications in Indonesia with categories from the Largest State Bank, First Mover, and Largest Private Bank. The limitation of this study is that the data analyzed are in the form of comments sourced from the Play Store, with a span of 3 months, with data sampling of 1000 data per application commented on. Academically, these findings enrich performance theory, especially regarding digital banks, that the positive and negative numbers illustrate the necessary strengthening of the current digital bank management model. For further research, this finding can be used to strengthen research on more effective application management models through the digital banking ecosystem. It is necessary to research the DBC connectivity on various variables, either affecting DBC or being affected by DBC. DBC can also continue to be tested for its suitability for measuring the effectiveness of an application, such as the banking system application in this study, by continuing to observe this theory and adapting to developments in the elements involved in digital bank operations. These findings can also be utilized by practitioners, especially the leaders of digital banks in Indonesia, to express user needs so that they are served according to their expectations. Several suggestions for existing application providers have also been presented in the managerial implications section.

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