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Exploring loyalty drivers for smartphone and mobile carriers

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Smartphones have permeated daily human life and play a role in various areas. Loyalty to smartphones holds significant implications for both businesses and customers. This study constructed a research model that considers smartphones as parallel to telecom services. The model comprises devices and mobile carriers as the main axes. The study designates exogenous variables as symmetric factors and common factors. The research collected empirical questionnaire responses from 357 smartphone users. Data analysis was conducted using partial least squares structural equation modeling. The findings revealed that brand image and apps are significantly related to device satisfaction. The results demonstrated that apps, corporate image, and perceived fees are crucial determinants of carrier satisfaction. The analysis also showed that both device satisfaction and mobile carrier satisfaction influence loyalty.

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Introduction

Since the introduction of the iPhone in 2010, smartphones have rapidly proliferated (Lee et al., 2021). These devices incorporate a range of computer functionalities within a compact operating system, far surpassing traditional phone capabilities (Singh and Samah, 2018). Users can engage in mobile banking (Purwanto et al., 2020), e-learning (Almaiah et al., 2022), shopping (Madan and Yadav, 2018), and social networking (Saleem et al., 2021) through applications on their smartphones. The global smartphone market is projected to grow at a CAGR of 7.3%, from \$484.81 billion in 2022 to \$792.51 billion by 2029 (FortuneBusinessInsights, 2021). Smartphones are increasingly used alongside telecom services, which have significantly advanced in speed, accuracy, and bandwidth (Wang et al., 2020). Together, smartphones and telecom services enable users to access cutting-edge features such as super-resolution video streaming (Zhang et al., 2021), virtual reality (Drakopoulos et al., 2021), and cloud computing (Malik et al., 2021).

Device-carrier loyalty is pivotal in understanding consumer behavior within the telecommunications industry. This loyalty extends beyond simple preference, reflecting a deep synergy between device performance and network quality. In technologically advanced markets like South Korea, the compatibility between mobile devices and carrier services crucially impacts user experience. Specific carriers may offer optimized network conditions for certain devices, thus enhancing features like 5G connectivity. Such optimization can heighten satisfaction and loyalty, as consumers experience superior service quality. Moreover, the rapidly evolving landscape of mobile technology suggests that device and carrier choices are deeply interconnected, influencing consumer decisions based on the combined quality of device functionality and network service. Understanding this interplay is vital for developing marketing strategies and enhancing consumer satisfaction.

Smartphone users take brand image into account when purchasing a product (Solihin et al., 2021). For instance, they might prefer a Samsung Galaxy over an Apple iPhone. Some users develop a strong attachment to their smartphone's brand and consistently select the same brand over a long period (Soedarto et al., 2019). Conversely, when choosing a mobile carrier, smartphone users consider the corporate image (Ting et al., 2020). In Korea, the three major carriers are SKT, KT, and LGU+. Unlike the smartphone device market, telecom service subscribers make decisions based on company reputations rather than solely on brand names. Individuals form a corporate image based on service quality, speed, and reputation. In the Korean telecom industry, there is no independent brand equivalent to the Galaxy or iPhone. Korean users recognize mobile carrier names as brands, and their satisfaction with the telecom is often expressed as "SKT is good." In summary, while smartphone users consider brand image when purchasing a smartphone, they reflect on the corporate image when choosing a mobile carrier.

As of December 2022, the latest mobile phones are the iPhone 14 and Samsung Galaxy S22 (Michaels, 2022), each starting at \$799. Given that the cost of a smartphone can be burdensome, users often opt for installment payments over the subscription period of a mobile carrier (Maddi and Shah, 2019). The fairness of smartphone pricing significantly impacts consumers' satisfaction with the device. Regarding telecom services, users select mobile carriers based on fees, call quality, or corporate image (Yu and Lee, 2022). Among these factors, Korean consumers particularly prioritize fees (Yu and Lee, 2022). Unlike purchasing a smartphone device, users subscribe to telecom services for a contracted period and make regular payments. They may be dissatisfied if they perceive the cost to be higher than the utility or

benefits provided. Conversely, they would be satisfied with the mobile carrier if the fees are perceived as reasonable.

Smartphones outperform basic phones as they offer a multitude of apps. Users spend more time using apps than making calls (Deng et al., 2019). Through smartphone apps, users work (Hochberg et al., 2018), learn (Alksasbeh et al., 2019), and engage in hobbies (Choi and Aizawa, 2019). For apps to function smoothly, both the device and network must perform well. If users find the apps useful and convenient, they are likely to be satisfied with both their smartphones and mobile carriers.

Call quality is a key feature of a mobile phone (Shin, 2012). Historically, feature phone users made calls through a dedicated communication network. Smartphone users now make calls using basic calling apps through dedicated telecom networks or voice-over Internet protocol (VoIP) apps such as Skype, Line, or KakaoTalk over a wireless network (Wuttidittachotti and Daengsi, 2015; Yoon, 2016). Call quality depends on both device and network performance. The higher the call success rate and the fewer disconnections, the more satisfied users will be with their devices and mobile carriers.

Loyalty to smartphone-mobile carriers is generated as follows: First, loyalty is determined by satisfaction with both the device and the mobile carrier. Second, the antecedents of satisfaction can be classified into symmetrical and common factors. Satisfaction with smartphones is influenced by brand image and price fairness, while satisfaction with mobile carriers may be influenced by corporate image and perceived fees. Image and cost are symmetric factors, whereas apps and call quality are common factors that affect satisfaction with both devices and mobile carriers. The better these factors are, the more satisfied users will be with both the device and mobile carrier.

This study addresses a significant research gap by adopting an integrated approach to understanding loyalty between the device and mobile carrier, an aspect not previously explored in-depth. Prior research often analyzed devices (Aldhaban, 2012; Chun et al., 2012; Kim, 2014) and mobile carriers (Kaur and Soch, 2018) separately. However, smartphones and telecom services are fundamentally interconnected, and this research delineates a mechanism for forming satisfaction by differentiating between devices and mobile carriers, ultimately elucidating factors driving loyalty. Furthermore, this paper delves into the factors influencing the satisfaction of both devices and mobile carriers within specific contexts. It reveals that smartphone users typically prioritize brand image over corporate image when selecting or purchasing a device. Conversely, mobile carrier subscribers are more likely to consider the corporate image, which functions similarly to a brand image for them. The satisfaction of smartphone users is primarily influenced by the product's price, whereas the satisfaction of mobile carrier subscribers is affected by the service fee. The comparison between brand image (versus corporate image) and price (versus fee) highlights mutual symmetries and slight semantic distinctions depending on the context. This study also introduces factors that commonly impact satisfaction with both devices and mobile carriers. It examines how apps and call quality influence satisfaction levels across smartphones and telecommunication services, providing crucial insights for app developers about which smartphone manufacturers or mobile carriers to prioritize. Additionally, it investigates whether call quality more significantly affects the device or the carrier.

The structure of this paper is as follows: "Literature Review" outlines the theoretical background; "Research Model" proposes a research model and formulates each hypothesis; "Research Methodology" describes the study methodology; "Results" presents the empirical results for the measurement model and the

structural model; “Discussion” discusses these results; and finally, “Conclusion” highlights theoretical contributions, practical implications, and acknowledges limitations.

Literature review

Smartphone (Device). The landscape of smartphone usage and the factors influencing user behavior have become a focal point of scholarly research, particularly as the functionality and roles of smartphones continue to evolve (Fook et al., 2021; Harris et al., 2020; Zhai et al., 2020). Recent studies have provided nuanced insights into the determinants of user behavior, including acceptance intention, post-adoption evaluation, and factors influencing both purchase and continued use (Baishya and Samalia, 2020; Lin et al., 2021; Mehra et al., 2022; Park, 2022).

The Technology Acceptance Model (TAM) remains a foundational framework for understanding smartphone user behaviors (Oyman et al., 2022; Rafique et al., 2020; Widanengsih, 2021). According to Davis (1989), perceived usefulness and ease of use are critical determinants of technology adoption. This model has been extensively applied and adapted in contemporary smartphone studies (Mohamad et al., 2021; Mohr and Kühl, 2021; Zhong et al., 2021). For example, Naruetharadhol et al. (2021) investigated mobile banking adoption, finding that both perceived usefulness and ease of use significantly influence users' intentions to use mobile banking apps. Similarly, Martín-García et al. (2022) examined smartphone adoption among older adults, noting a significant impact of perceived ease of use on their acceptance and continued use. These studies affirm TAM's robustness and adaptability in addressing the evolving nature of smartphone technology and its applications across various user segments. Additionally, Debasa et al. (2023) explored how stress and anxiety affect the intention to make restaurant reservations through mobile apps, enhancing the TAM by integrating these psychological factors. Their findings reveal that although stress does not directly impact perceived usefulness and ease of use, the broader interplay of stress, anxiety, and these factors significantly affects user attitudes and decision-making processes.

The role of brand-related factors in shaping purchase intentions has also been extensively documented. Mao et al. (2020) emphasized the critical role of brand image, communication, and identity in influencing purchase intentions, mediated by the flow experience, highlighting the significant impact of brand perceptions in decision-making processes. Similarly, Rakib et al. (2022) identified significant effects of brand image, product features, and price on smartphone purchase intentions.

Additionally, the extension of the Theory of Planned Behavior to include privacy concerns has shown that issues related to improper access can deter purchase intentions, underscoring the growing importance of data security in consumer evaluations (Belkhamza et al., 2019). Moreover, the influence of electronic word of mouth (E-WOM) on brand image and purchase intention has been affirmed, illustrating the power of social influence in the digital age (Alrwashdeh et al., 2019).

The Expectation-Confirmation Model (ECM) has been pivotal in examining smartphone user behaviors, particularly in relation to satisfaction and continuance intention (Kumar and Natarajan, 2020; Tam et al., 2020; Yousaf et al., 2021). ECM posits that users' continuance intention is influenced by their initial expectations, perceived performance, and the extent of expectation confirmation (Bhattacharjee, 2001). Research applying ECM to smartphone use has demonstrated that satisfaction serves as a crucial mediating factor between expectation confirmation and users' loyalty to a mobile brand (Aslam et al., 2019; Liang et al., 2018; Sudirjo et al., 2023). Additionally, Dewi et al. (2022) explored the moderating effect of E-WOM on ECM, particularly among

Blackberry smartphone users in Solo Region, Central Java, Indonesia. Their findings suggest that E-WOM significantly affects the relationship between confirmation, perceived usefulness, satisfaction, and continuance intention, emphasizing the need for companies to effectively manage E-WOM to boost consumer loyalty towards IT products. These adaptations of ECM underscore its versatility and applicability in understanding the dynamic aspects of smartphone user satisfaction and loyalty.

In summary, prior research has analyzed smartphone user behavior through various theoretical lenses including information technology (IT), ECM, brand, and behavioral theories. Although many studies have examined brand image, price, and apps, there remains a gap in research exploring integrated loyalty to both smartphones and telecom companies.

Telecom service (Mobile Carrier). The evolution of telecom services, especially mobile carriers, has been at the forefront of academic research due to its significant impact on consumer behavior and market dynamics (Butkouskaya et al., 2021; Meena and Geng, 2022; Patel, 2023; Sudharsan and Ganesh, 2022). Recent research has particularly focused on the digitalization of customer service and its implications for customer satisfaction and loyalty in the telecom sector. Awadhi et al. (2021) studied this phenomenon in the United Arab Emirates, finding that digital solutions correlate strongly with increased customer satisfaction, supported by Expectancy-Disconfirmation and Evaluation Congruity Theories. This indicates that digitalization not only meets but exceeds customer expectations, thereby enhancing overall satisfaction. Concurrently, e-service quality has emerged as a key determinant of customer loyalty and satisfaction, as evidenced by Zhou et al. (2019). Their development of a five-dimensional e-service quality (e-SQ) measurement scale within the telecom industry highlights the importance of e-SQ in cultivating customer loyalty, suggesting that satisfying digital service experiences are crucial for maintaining customer relationships.

The changing landscape of telecom services has also emphasized the importance of service recovery justice strategies, particularly during unexpected challenges such as the Covid-19 pandemic. Al-Dmour et al. (2021) demonstrated how these strategies effectively enhance online customer engagement in Jordan's telecom sector, with customer satisfaction acting as a vital mediator. This underlines the importance of proficient service recovery in sustaining customer trust and loyalty during crises. In terms of leveraging technology to strengthen customer relationships, Wassouf et al. (2020) showed how Syriatel Telecom Company uses big data analytics to segment customers and predict loyalty. Their innovative time-frequency-monetary approach for customer segmentation and subsequent application of classification algorithms illustrate big data's potential to tailor offerings and enhance loyalty, showcasing the strategic use of data analytics in understanding and influencing customer behavior.

Further expanding on the determinants of customer loyalty, Kalia et al. (2021) and Demir et al. (2021) explore the roles of service quality, trust, and commitment in shaping customer loyalty within the telecommunications industry. Kalia et al. (2021) analyze the impact of service quality dimensions—responsiveness, assurance, empathy—on customer loyalty among Indian telecom service users, highlighting how commitment and trust mediate these relationships. Their findings suggest nuanced effects based on variables such as marital status, gender, and connection type, offering targeted strategies for telecom providers to enhance user loyalty. Conversely, Demir et al. (2021) focus on the telecommunications sector in the Kurdistan region of Iraq, investigating how trust, corporate image, and switching costs influence customer loyalty and satisfaction. Their research reveals

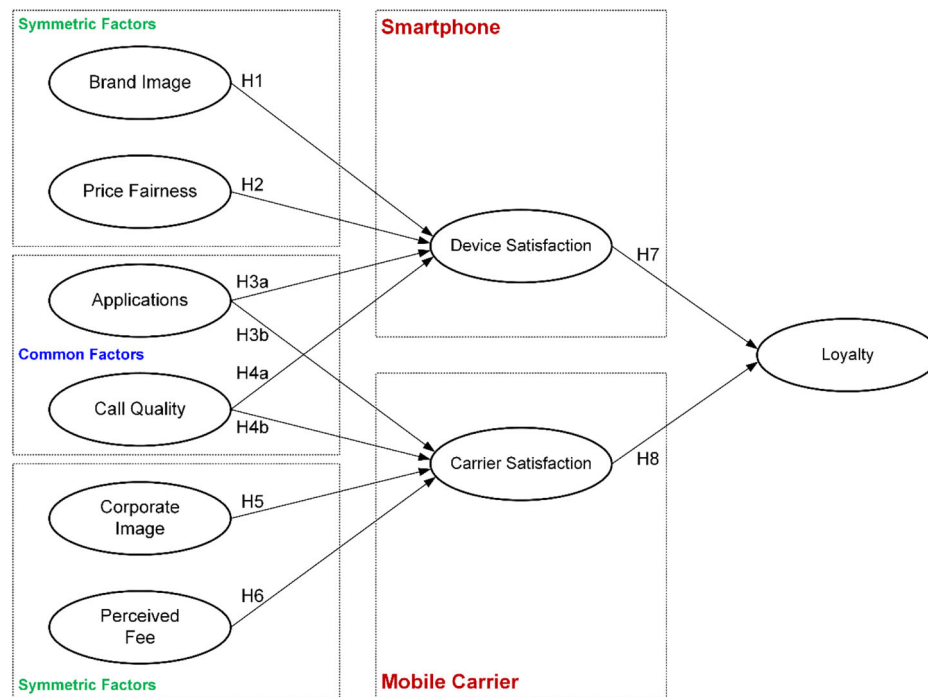


Fig. 1 Research Framework.

significant direct and indirect impacts of these factors, with satisfaction serving as a crucial mediator and underscoring the role of conflict handling across different cultural contexts.

Patel (2023) delves into the reasons behind brand switching in the mobile service industry, identifying key factors such as technology, competitive edge, pricing, switching costs, and service encounter failures. His study demonstrates that while technology and pricing may deter loyalty, switching costs and service failures actively drive customers to change providers. This research provides essential insights into consumer behavior, guiding mobile service providers worldwide to refine their marketing strategies and enhance customer retention.

This synthesized review encapsulates the multifaceted research on telecom service users, highlighting ongoing trends and areas for future research in the rapidly evolving telecom industry.

Research model

This study aims to elucidate loyalty towards the smartphone-mobile carrier combination, standing as one of the primary contributions of our research. We adopt a symmetrical approach to examine the determinants influencing consumer decisions towards both smartphones and mobile carriers. Additionally, our research introduces applications and call quality as concurrent factors affecting satisfaction with both devices and carriers.

Figure 1 presents an analytical framework designed to identify the precursors to loyalty among mobile service users. The formation of loyalty is conceptualized along two dimensions: satisfaction with smartphone devices and satisfaction with mobile carriers. It is hypothesized that brand image, price fairness, applications, and call quality are determinants of device satisfaction. Similarly, applications, call quality, corporate image, and perceived fees are hypothesized to influence satisfaction with mobile carriers, illustrating a comprehensive model of how these variables contribute to overall consumer loyalty.

Brand Image. Brand image is defined as the collective perceptions of a brand as held in consumers' minds (Benhardy et al., 2020). It significantly influences consumer behavior and perceptions during

the product evaluation process, playing a critical role in shaping purchase intentions and overall product satisfaction (Mao et al., 2020; Zhang, 2015). The link between a strong brand image and higher consumer satisfaction is well-documented, indicating that a positive brand image can lead to increased satisfaction with the product (Büyükdag, 2021; Diputra and Yasa, 2021; Zhang, 2015). Based on this evidence, the study hypothesizes that a favorable brand image will enhance satisfaction with the device.

H1. Brand image positively affects device satisfaction.

Price fairness. Price fairness is the consumer's subjective judgment of whether a price is considered just or unjust (Radic, 2023). This perception is crucial in determining consumer satisfaction, where a fair price is often associated with higher satisfaction levels with the purchased product (Chubaka Mushagalusa et al., 2022; Konuk, 2019). In the context of smartphones, if consumers perceive the price they paid as reasonable, this belief reinforces their satisfaction with their choice, leading to a positive evaluation of the device (Qalati et al., 2019). Consequently, this study proposes that price fairness is a significant determinant of device satisfaction.

H2. Price fairness positively affects device satisfaction.

Applications. Applications refer to software that users can download and use on their smartphones, providing a range of functionalities that enhance user experience through diversity, usefulness, convenience, and reliability (Kim et al., 2016; Xu et al., 2015). The ecosystem of smartphone applications is influenced by the synergy between manufacturers and mobile carriers, with some applications being exclusive to specific operating systems or tailored to the offerings of particular carriers (Stocchi et al., 2022; Thirumoorthy, 2020). This intricate relationship suggests that user perceptions of applications impact satisfaction levels with both the device and the mobile carrier. Thus, this paper hypothesizes that a positive reception of applications will enhance satisfaction with both the device and the mobile carrier.

H3a. Applications positively affect device satisfaction.

H3b. Applications positively affect mobile carrier satisfaction.

Call quality. Call quality, characterized by the absence of drop-outs and noise during voice calls, serves as a fundamental benchmark for evaluating mobile communication services (Abd-Elrahman, 2022). This metric depends on both the device's capabilities and the quality of the cellular network, underscoring the interdependence between hardware performance and service provision (Kamal et al., 2021; Kumar et al., 2022; Saeed and Alsharidah, 2021). High-quality call experiences require the seamless functioning of both components (Osman et al., 2020). Conversely, poor call quality, whether due to device shortcomings or network issues, detracts from the overall user experience and affects satisfaction levels (Abd-Elrahman, 2023). Therefore, this paper posits that call quality is a critical determinant of satisfaction in both the device and mobile carrier domains.

H4a. Call quality positively affects device satisfaction.

H4b. Call quality positively affects mobile carrier satisfaction.

Corporate image. Corporate image encompasses consumers' perceptions of quality, their satisfaction with services received, and brand loyalty (Yazid et al., 2020). In the context of mobile carriers, corporate image specifically refers to how consumers perceive the brand image of their mobile service providers. Literature consistently shows a significant link between corporate image and customer satisfaction, with corporate image serving as a key predictor of satisfaction levels (Khoo, 2022; Özkan et al., 2020). Therefore, this study posits that a positive corporate image of mobile carriers plays a pivotal role in fostering customer satisfaction.

H5. Corporate image positively affects mobile carrier satisfaction.

Perceived fee. Perceived fee is defined as the cost perceived by customers as necessary to access a service (Blut et al., 2023). It plays a critical role in shaping the behavioral intentions of users, especially in the context of mobile data services, where the perception of fee fairness and reasonableness can significantly influence customer satisfaction (Alzoubi and Inairat, 2020; Atmaja and Yasa, 2020). Literature suggests that when consumers perceive the fees associated with mobile data services as reasonable, their satisfaction with the service provider increases (Dasanayake and Herath, 2020). Given this relationship, this study argues that a fair and justifiable perceived fee positively impacts satisfaction with mobile carriers, highlighting the importance of pricing strategies in customer satisfaction.

H6. Perceived fee positively affects mobile carrier satisfaction.

Device satisfaction. Satisfaction is defined as a customer's overall feeling of pleasure or disappointment resulting from comparing a product's perceived performance (or outcome) against their expectations (Kotler et al., 2018). In this study, device satisfaction specifically refers to the comprehensive judgment of smartphones. The link between satisfaction and loyalty has been robustly established, indicating that satisfied consumers are more inclined to remain loyal to a product or brand (Naini et al., 2022; Subandi and Hamid, 2021). This relationship is particularly pronounced in the context of smartphones, where satisfaction with the device significantly influences the likelihood of consumer loyalty (Diputra and Yasa, 2021; Herrera-Enríquez et al., 2023; Nainggolan and Hidayet, 2020). Based on these findings, this paper argues that satisfaction with a device is a critical determinant of loyalty towards it.

H7. Device satisfaction positively affects loyalty.

Mobile carrier satisfaction. In the context of this study, mobile carrier satisfaction is defined as the affective reaction consumers

have based on their initial expectations of the mobile carrier. Empirical research across various studies underscores the significant positive impact that satisfaction has on loyalty, demonstrating that higher levels of satisfaction contribute to increased loyalty among users (Khairawati, 2020; Muharam et al., 2021; Saibil, 2020). Given this consistent association between satisfaction and loyalty, this research argues that satisfaction with a mobile carrier is a crucial driver of loyalty towards that carrier.

H8. Mobile carrier satisfaction positively affects loyalty.

Research methodology

Measurement instrument. To ensure relevance and precision, this study employed constructs adapted from measurement scales previously validated in similar research, specifically tailored to the context of smartphones. Initially crafted in English by the author, the questionnaire was translated into Korean by a bilingual researcher specializing in information systems. A bilingual professional subsequently conducted a back-translation into English. Minor discrepancies between the two English versions were meticulously refined by the author. Prior to deployment, the questionnaire underwent rigorous evaluation by two experts in the fields of information technology and telecommunications to enhance its accuracy and relevance. A pilot study involving 15 participants (Akter et al., 2010) was instrumental in refining the questionnaire, significantly enhancing its completeness. Feedback from this preliminary study was pivotal in finalizing the questionnaire's format and content. For the main survey, all variables—with the exception of demographic information and frequency—were measured using a 7-point Likert scale, providing a nuanced spectrum of responses. Special attention was given to measuring call quality; participants were instructed to reflect on their experiences with both default calling applications and VoIP services to provide a comprehensive assessment of this aspect. Table A1 in the appendix details the measurement items for each construct, ensuring transparency and facilitating replication of the study.

Subjects and data collection. The theoretical model was empirically validated using data obtained from an online-based survey. The survey link was distributed to smartphone users from September 5th to September 23rd, 2022. This study employed convenience sampling as its data collection method, a non-probability sampling technique involving selecting subjects who are easily accessible and willing to participate (Obilor, 2023). This approach was deemed appropriate for our research due to several reasons: it allowed for efficient data collection within a limited timeframe, crucial for capturing timely and relevant insights into consumer perceptions and behaviors; and given the broad and diverse nature of the study's target population—smartphone users with varying brand loyalties, price sensitivities, and usage behaviors—convenience sampling enabled us to quickly gather a wide range of responses, enhancing the richness and diversity of our data. Data collection was conducted through a partnership with operators of cellphone retail outlets in South Korea, who assisted in distributing surveys to their customers. Respondents participated voluntarily and provided their responses free of charge. The first page of the questionnaire included a question asking for consent to publish the research results, with only consenting participants proceeding to the main survey. After filtering out incomplete responses, 357 responses were analyzed.

To determine the optimal sample size, we used the A-priori Sample Size Calculator for Structural Equation Models (SEMs) (Soper, 2024). This strategic approach helped us accurately estimate the minimum sample size required for reliable outcomes, considering our model's complexity, which includes 9 latent and

26 observed variables. With an anticipated effect size of 0.1, a desired statistical power level of 0.8, and a probability level of 0.05, the calculator recommended a minimum sample size of 218 to adequately support the model’s structure. Our final sample size not only meets but exceeds this recommendation, ensuring the robustness and validity of our findings.

The demographic breakdown of the sample showed that 198 participants (55.5%) were male and 159 (44.5%) were female, with the highest frequency in their 20 s at 100 (28.0%), followed by those in their 40 s at 92 (25.8%). The majority of participants were using Samsung phones (254, 71.1%), followed by iPhones (92, 25.8%), with most subscribers to SKT (204, 57.1%). Table 1 displays the demographic details of the samples.

Table 2 illustrates the distribution of smartphone brands (Samsung, Apple, and Other) among mobile carriers (SKT, KT, LGU+, and MVNO) in our study. Samsung dominates the market with a 71.1% share, significantly ahead of Apple at 25.8%, and others at 3.1%. SKT emerges as the leading carrier, serving 57.1% of the sample.

Results

In this study, we utilized SmartPLS 4.0 for our analysis, leveraging the partial least squares (PLS) method. This choice was driven by the method’s proven utility and suitability for exploratory research in the IT/IS fields, where complex models and non-normal data distributions are common (Al-Emran et al., 2018). SmartPLS 4.0 is particularly well-suited for our study due to its robustness in handling both formative and reflective measurement models, its capability to evaluate complex relationships within our model, and its ability to provide reliable results even with smaller sample sizes (Cheah et al., 2024). The analysis was conducted in two phases: initially assessing the reliability, convergent validity, and discriminant validity of the measurement model, followed by a thorough examination of the structural

model. This two-stage approach ensured a rigorous evaluation of both the measurement and structural components of our model, affirming the software’s predictive validity and its suitability for our research objectives.

Common Method Bias (CMB). In alignment with established methodologies to evaluate CMB, this study employed the principal component analysis method alongside Harman’s one-factor test (Harman, 1976) using SPSS software. According to Harman’s criterion, CMB is present if a single construct explains more than 50% of the variance within the data. The results of this analysis indicated that the largest variance explained by a single construct amounted to only 42.72% of the total variance, suggesting that CMB is not a concern in the current dataset.

Measurement Model. This research conducted a confirmatory factor analysis to assess reliability, convergent validity, and discriminant validity (Table 3). Measure reliability was assessed using composite reliability (CR) and Cronbach’s alpha. The results for composite reliability (CR) were greater than 0.7, indicating that the model exhibits good internal consistency (Nunnally, 1978). The lowest value of Cronbach’s alpha was 0.738, which meets the recommended criteria (Nunnally, 1978).

Convergent validity is considered acceptable when the factor loading is above 0.70 (Hair et al., 2006) and the average variance extracted (AVE) is over 0.5 (Fornell and Larcker, 1981). In this study, convergent validity was confirmed as all factor loadings exceeded 0.70 and all AVE values were greater than 0.50.

The current study confirmed the discriminant validity of two criteria. First, it employed the Fornell-Larker criterion (Fornell and Larcker, 1981). The root square of AVE was compared to the correlations among constructs to examine discriminant validity. As seen in Table 4, all of the diagonal elements were above any other corresponding rows or column elements.

Second, the HTMT ratio was computed. Table 5 shows that the scores for each construct are all below the cutoff of 0.85 except the one between perceived fee and loyalty (Henseler et al., 2016). This research proceeded with the analysis as reliability, convergent validity, and discriminant validity based on Fornell-Larcker were all satisfied.

Structural model. This study examined the model fit index. The standardized root mean square was 0.047, which was less than the recommended threshold of 0.08 (Bentler and Bonett, 1980). It is recommended that D_ULS (i.e., the squared Euclidean distance) and d_G (i.e., the geodesic distance) are less than 95% bootstrapped quantile (Henseler et al., 2016). D_ULS and d_G were 0.837 and 0.556, respectively. The Chi-square value was 1212.836. Therefore, the measurement model shows a satisfactory fit.

SEM analysis was conducted to test and confirm the hypothesized relationships among the constructs of this study. This study applied a bootstrapping approach (bootstrapping subsample = 5000) to test the proposed hypothesis and path coefficients (Fig. 2).

Table 6 describes the SEM results. Consistent with the hypothesis, device brand image has a significant positive impact

Table 1 Demographic characteristics of the samples.			
Demographics	Item	Subjects (N = 357)	
		Frequency	Percentage
Gender	Male	198	55.5%
	Female	159	44.5%
Age	10 s	49	13.7%
	20 s	100	28.0%
	30 s	85	23.8%
	40 s	92	25.8%
	50 s	28	7.8%
	60 s	3	0.8%
Device Manufacturer	Samsung	254	71.1%
	Apple	92	25.8%
	Other	11	3.1%
Mobile Carrier	SKT	204	57.1%
	KT	73	20.4%
	LGU+	64	17.9%
	Mobile Virtual Network Operator	16	4.5%

Table 2 Distribution of smartphone brands across mobile carriers.					
Category	SKT	KT	LGU+	MVNO	Total
Samsung	147 (41.2%)	54 (15.1%)	44 (12.3%)	9 (2.5%)	254 (71.1%)
Apple	52 (14.6%)	15 (4.2%)	19 (5.3%)	6 (1.7%)	92 (25.8%)
Other	5 (1.4%)	4 (1.1%)	1 (0.3%)	1 (0.3%)	11 (3.1%)
Total	204 (57.1%)	73 (20.4%)	64 (17.9%)	16 (4.5%)	357 (100%)

Table 3 Scale reliability.

Construct	Items	Mean	St. Dev.	Factor Loading	Cronbach's Alpha	CR (rho_a)	CR (rho_c)	AVE
Brand image	BIM1	5.266	1.355	0.915	0.911	0.913	0.944	0.849
	BIM2	5.387	1.327	0.916				
	BIM3	5.221	1.418	0.934				
Price fairness	PFA1	3.933	1.710	0.920	0.906	0.909	0.941	0.842
	PFA2	3.983	1.643	0.919				
	PFA3	4.333	1.622	0.913				
Applications	APP1	5.426	1.215	0.897	0.934	0.945	0.958	0.884
	APP2	5.387	1.205	0.960				
	APP3	5.378	1.198	0.962				
Call quality	CQL1	5.725	1.217	0.872	0.870	0.872	0.920	0.794
	CQL2	5.493	1.421	0.901				
	CQL3	5.479	1.371	0.900				
Corporate image	CIM1	4.894	1.453	0.924	0.936	0.939	0.959	0.886
	CIM2	5.011	1.455	0.954				
	CIM3	4.846	1.473	0.947				
Perceived fee	PFE1	4.524	1.483	0.853	0.846	0.850	0.907	0.765
	PFE2	3.877	1.715	0.901				
	PFE3	3.325	1.719	0.868				
Device satisfaction	DSA1	5.168	1.232	0.914	0.895	0.897	0.935	0.827
	DSA2	4.896	1.389	0.882				
	DSA3	4.975	1.310	0.931				
Mobile carrier satisfaction	MCS1	5.070	1.304	0.921	0.915	0.915	0.946	0.855
	MCS2	4.910	1.383	0.928				
Loyalty	LYT1	4.717	1.260	0.869	0.738	0.755	0.851	0.656
	LYT2	4.367	1.496	0.779				
	LYT3	4.818	1.560	0.778				

Table 4 Fornell-Larcker criterion.

Constructs	1	2	3	4	5	6	7	8	9
1. Brand image	0.922								
2. Price fairness	0.373	0.917							
3. Applications	0.527	0.330	0.940						
4. Call quality	0.306	0.185	0.366	0.891					
5. Corporate image	0.600	0.324	0.427	0.347	0.941				
6. Perceived fee	0.384	0.574	0.350	0.272	0.490	0.874			
7. Device satisfaction	0.696	0.349	0.568	0.280	0.510	0.460	0.909		
8. Mobile carrier satisfaction	0.608	0.400	0.486	0.342	0.799	0.485	0.566	0.924	
9. Loyalty	0.620	0.400	0.523	0.249	0.563	0.493	0.808	0.611	0.810

Table 5 HTMT ratio.

Constructs	1	2	3	4	5	6	7	8	9
1. Brand image									
2. Price fairness	0.410								
3. Applications	0.570	0.359							
4. Call quality	0.342	0.207	0.406						
5. Corporate image	0.650	0.352	0.456	0.382					
6. Perceived fee	0.432	0.656	0.386	0.309	0.548				
7. Device satisfaction	0.770	0.386	0.615	0.315	0.557	0.526			
8. Mobile carrier satisfaction	0.666	0.438	0.524	0.383	0.862	0.547	0.626		
9. Loyalty	0.754	0.488	0.625	0.304	0.674	0.618	0.986	0.737	

on device satisfaction ($\beta = 0.531$, $t = 10.083$), strongly supporting H1. In contrast to prediction, price fairness does not affect device satisfaction ($\beta = 0.062$, $t = 1.287$), failing to accept H2. In line with the hypothesis, apps are significantly related to both device satisfaction ($\beta = 0.264$, $t = 5.635$) and mobile carrier satisfaction ($\beta = 0.156$, $t = 3.73$), supporting H3a and H3b. Unexpectedly, call quality does not have a significant influence on both device satisfaction ($\beta = 0.009$, $t = 0.215$) and mobile carrier satisfaction

($\beta = 0.025$, $t = 0.616$), failing to support H4a and H4b. Consistent with prediction, the corporate image has a significant association with mobile carrier satisfaction ($\beta = 0.68$, $t = 17.452$), strongly supporting H5. As expected, perceived fee has a significant correlation with mobile carrier satisfaction ($\beta = 0.09$, $t = 2.53$), supporting H6. As proposed, device satisfaction is significantly related to loyalty ($\beta = 0.681$, $t = 19.098$), strongly supporting H7. As expected, mobile carrier satisfaction has a significant

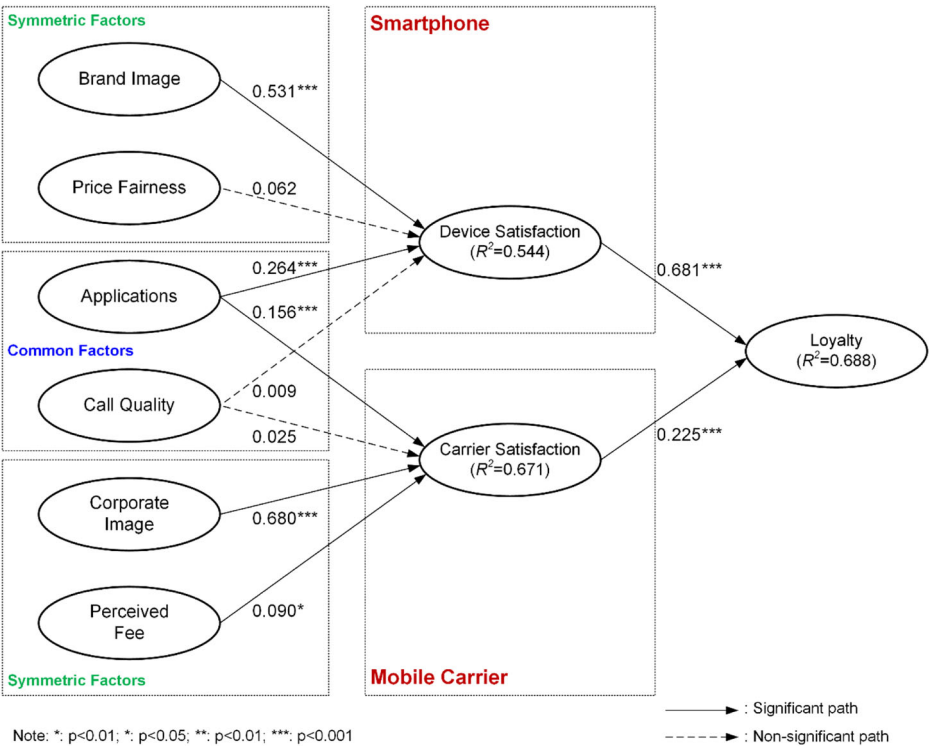


Fig. 2 PLS Algorithm Results.

Table 6 Analysis of path coefficients.					
H	Cause	Effect	Coefficient	t-value	Hypothesis
H1	Brand image	Device satisfaction	0.531	10.083	Supported
H2	Price fairness	Device satisfaction	0.062	1.287	Not supported
H3a	Applications	Device satisfaction	0.264	5.635	Supported
H3b	Applications	Mobile carrier satisfaction	0.156	3.730	Supported
H4a	Call quality	Device satisfaction	0.009	0.215	Not supported
H4b	Call quality	Mobile carrier satisfaction	0.025	0.616	Not supported
H5	Corporate image	Mobile carrier satisfaction	0.680	17.452	Supported
H6	Perceived fee	Mobile carrier satisfaction	0.090	2.530	Supported
H7	Device satisfaction	Loyalty	0.681	19.098	Supported
H8	Mobile carrier satisfaction	Loyalty	0.225	5.947	Supported

association with loyalty ($\beta = 0.225$, $t = 5.947$), supporting H8. Overall, the structural model explained approximately 68.8% of the variation in loyalty.

Discussion

This study aimed to elucidate the factors influencing combined loyalty among smartphone users by examining both the device and the mobile carrier. The analysis confirmed that a strong brand image positively affects device satisfaction, aligning with previous findings that suggest a robust brand image enhances user satisfaction (Diputra and Yasa, 2021; Zhang, 2015). Contrarily, the results indicated that price fairness does not significantly impact device satisfaction, diverging from prior studies that identify it as a critical determinant of satisfaction (Jin et al., 2012; Konuk, 2019). This discrepancy may be attributed to users’ perceptions that smartphone prices exceed reasonable expectations, although the enhanced utility and entertainment value of smartphones appear to mitigate these concerns. The study also found that effective app functionality positively influences both device and mobile carrier satisfaction. This likely results from the interdependence of app performance on both the

smartphone’s capabilities and the network quality, enhancing overall user satisfaction with both the device and the carrier. Interestingly, call quality did not significantly influence satisfaction with either the device or the carrier. This could be due to the high standards of modern smartphones and communication networks, which have normalized excellent call quality across devices and carriers, thus diminishing its impact on user satisfaction. Corporate image was found to significantly influence mobile carrier satisfaction, supporting findings from previous research (Iqbal et al., 2017). Users who favor a carrier’s image tend to report higher satisfaction. Additionally, perceived fee fairness was significantly associated with mobile carrier satisfaction, consistent with prior research that suggests reasonable fees enhance carrier satisfaction (Kim et al., 2010). Furthermore, the study confirmed that device satisfaction significantly enhances loyalty, corroborating earlier research (Daud et al., 2018; Naini et al., 2022). Users who are satisfied with their smartphones are more likely to remain loyal to their smartphone-carrier combination.

Finally, mobile carrier satisfaction was found to significantly influence loyalty, echoing findings from past research (Chen et al., 2015; Chen, 2012; Saibil, 2020). Higher satisfaction with carriers is associated with increased loyalty to the smartphone-carrier union.

These findings elucidate the intricate relationships between device and carrier attributes and their impact on user loyalty, offering valuable insights for industry stakeholders aiming to enhance customer retention and satisfaction.

Conclusion

Theoretical contributions. This study significantly enriches the academic literature in several ways. Firstly, it deepens our understanding of smartphone user loyalty by considering both the device and the telecom company collectively, a perspective rarely emphasized in prior research. Previous studies have typically focused on loyalty to either a device (Kim et al., 2020; Kim et al., 2015; Yeh et al., 2016) or a carrier (Kim and Yoon, 2004; Kim et al., 2004) in isolation. This paper underscores the inseparable nature of the communication service that integrates both a device and a network, thus offering a more comprehensive view of what influences user loyalty.

Secondly, this article enhances the smartphone literature by demonstrating that device satisfaction is significantly influenced by brand image and app performance. It highlights the importance of brand perception in the consumer decision-making process and suggests that app functionality is closely tied to the device's specifications. This finding prompts further research into what constitutes optimal brand imaging to enhance user satisfaction, especially in light of customer critiques regarding lack of updates or the high cost of devices (Chun et al., 2022; Poppelaars et al., 2018). Future studies could explore brand imaging strategies in the context of new technological features and pricing models.

Thirdly, the paper offers new insights into mobile carrier research by revealing that carrier satisfaction is influenced by apps, corporate image, and perceived fees. The quality of the network significantly affects the performance of communication-based apps, which in turn influences user satisfaction. It also shows that users in Korea consider both the image and the costs associated with carriers when making their choices. Future academic work could delve deeper into understanding the most downloaded apps per carrier and the rationale behind these preferences. Additionally, there is a need for quantitative analysis of fee structures that balance corporate profitability with maximizing consumer satisfaction, and a closer examination of why consumers prioritize brand image for devices and corporate image for carriers in their decision-making processes.

Fourthly, the findings of our study elucidate a differential impact of device and carrier on consumer loyalty within the telecommunications sector, suggesting that devices exert a more substantial influence on loyalty than carriers. This distinction supports the theoretical advancement of loyalty models by incorporating the relative strength of product versus service attributes. It reinforces the notion that consumer loyalty is more resilient to product brand attachment than to service provider selection, indicating a deeper psychological commitment to devices. This aspect extends the Dual Mediation Hypothesis, emphasizing the primary role of emotional attachment to the device over mere satisfaction with the carrier, which could pivot future theoretical frameworks toward a more nuanced understanding of loyalty determinants.

Finally, the model of this work makes a remarkable contribution to academia in that it accounts for 68.8% of the variance of combined loyalty. The model presented in this paper can be

extended and applied not only to combined loyalty but also to combined satisfaction, combined word of mouth, and combined repurchase intention.

Practical implications. This paper presents several practical implications. Firstly, the analysis confirmed that satisfaction with smartphones and mobile carriers influences loyalty. Consequently, smartphone manufacturers need to identify which carriers their customers prefer, and carriers should determine which smartphones their subscribers favor. This research enables manufacturers and carriers to recommend optimal configurations and drive improvements by identifying device-carrier combinations that garner less loyalty.

Secondly, this study offers valuable insights for professionals by demonstrating that brand image and app functionality contribute to device satisfaction. Marketers should focus on enhancing customer satisfaction and retention by continuously strengthening the smartphone brand image. They should clearly articulate the features introduced in new versions and how these differ from competing products. For instance, advertising planners could highlight upgraded features such as enhanced artificial intelligence capabilities that enable parasocial interactivity (Chaturvedi et al., 2023). App developers and device manufacturers could collaborate more effectively to launch better-performing apps alongside new smartphone releases, creating synergistic benefits.

Thirdly, from a managerial standpoint, the pronounced loyalty to devices over carriers observed in our study suggests that telecommunications companies should prioritize collaborations with popular device manufacturers to enhance customer retention and satisfaction. By aligning service offerings with preferred device ecosystems, carriers can leverage the strong brand loyalty consumers exhibit towards their devices to boost their own customer loyalty. Additionally, this insight can guide carriers in designing targeted marketing strategies and loyalty programs that emphasize the synergies between their services and popular devices, potentially mitigating the ease with which consumers switch carriers by enhancing the perceived value of staying with a particular service provider.

Finally, this study demonstrates that apps, corporate image, and perceived fees enhance carrier satisfaction. App developers and telecom companies can facilitate the adoption of new technologies by proactively sharing information about advancements, such as the rollout of 6G networks. Marketing teams should strive to cultivate a consumer-friendly brand for telecom companies, emphasizing attributes like stable networks, high speed, and global connectivity. Pricing managers need to continuously assess consumer perceptions of pricing and usage patterns. Mobile carriers should analyze future consumer usage trends and implement services that recommend customized rate plans based on individual needs.

Limitation and further research. First, this study did not account for various exogenous variables. Future research should incorporate additional explanatory variables, such as device functionality, network experience, and peer influence, to provide a more comprehensive analysis. Second, this study did not consider device manufacturers and telecom companies as control variables. The results of the study model may vary depending on the specific manufacturers and carriers involved. Future studies could gain more detailed insights by categorizing user groups according to specific manufacturers and carriers. Third, this work did not consider the point of purchase of the smartphone. Customers using newer products may have a higher level of satisfaction compared to those using older products. It will be valuable for subsequent studies to reflect the timing of users' product purchases. Fourth, our study's measurement of loyalty primarily

focused on comparative satisfaction and referral willingness, which may not fully capture the traditional marketing definition of loyalty that includes price insensitivity and future behavioral intentions. Recognizing this as a limitation, future research should aim to incorporate a broader spectrum of loyalty indicators, such as resistance to competitive offers and explicit intentions regarding continued patronage or switching. Finally, our research did not distinguish between true loyalty and the effects of customer lock-in, such as high switching costs or contractual obligations that may compel customers to remain with a service. Future studies should explore this distinction further, potentially employing models like the Push-Pull-Mooring framework to differentiate between the voluntary allegiance of loyalty and the forced adherence due to lock-in.

Data availability

The data supporting the findings of this study are openly available as supplementary files accompanying the final article submission to the journal. The dataset consists of responses from 357 participants and has been provided in a single CSV file. Each column header in the CSV file corresponds to the specific survey measurement items used in this study, facilitating transparency and reproducibility of the analysis. Researchers and readers can access this dataset to replicate the analysis in accordance with the methodology described in this paper. This ensures that our research adheres to the principles of data transparency and allows for independent verification of our findings.

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Author contributions

HJ wrote the original manuscript of this study. DHP was responsible for the revision of the article.

Competing interests

The authors declare no competing interests.

Ethical approval

This study was conducted in accordance with the guidelines of the Declaration of Helsinki. The research subject is unspecified, and the information collected through the research does not contain sensitive information in accordance with Article 23 of the Personal Information Protection Act of Korea and is exempted from IRB review.

Informed consent

Consent to participate in the study was explicitly obtained from all participants. During the data collection period from September 5th to September 23rd, 2022, the first page of the online questionnaire included a detailed consent form. Participants were required to actively confirm their consent by checking a box before proceeding to the main survey. This process ensured that all respondents were fully informed about the purpose of the study and the use of the data collected.

Additional information

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