An Outlook on the System Dynamics Approach to Boost the Adoption of Mobile Games

Hendra Dinata [1,2], Erma Suryani [3,*], and Jerry Dwi Trijoyo Purnomo [4]

[1] Department of Technology Management, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia
[2] Department of Informatics Engineering, Universitas Surabaya, Surabaya, Indonesia
[3] Department of Information Systems, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia
[4] Department of Statistics, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia
Email: hdinata@staff.ubaya.ac.id (H.D.); erma.suryani@gmail.com (E.S.); jerry@statistika.its.ac.id (J.D.T.P.)
*Corresponding author

***Abstract*—Mobile games are a platform within the video game business that developers may use to generate revenue. Acquiring many users is crucial to increasing revenue from mobile games, as these users are the ones who generate the cash. This paper not only captures the current behavior of mobile game users but, by using the System Dynamics (SD) method, we can get a more comprehensive model of how the mobile game usage system works and provide a reliable forecast regarding the future trends in mobile game adoption rates. Utilizing scenario design with optimistic and pessimistic projections can help identify strategic actions the developer can implement to enhance user acquisition for the mobile game. The scenario design in this paper indicates that the active users of mobile games might grow by 49.21% by implementing advertising campaigns, word-of-mouth techniques, heightened product awareness, establishing customer relations, and preserving product ratings, as well as by projecting a growth rate of new smartphone users of 17.78 million people annually.**

***Keywords*—mobile game, user acquisition, adoption, System Dynamics (SD), scenario**

I. Introduction

In essence, individuals engage in games for the purpose of amusement, and video games were introduced to provide an electronic version of games that may be enjoyed using specific equipment. Jung *et al.* [1] assert that engaging in video gaming has become an integral aspect of human culture in everyday life, particularly on mobile platforms. Consequently, video games will continuously evolve until they become independent businesses. The video game industry alone generated over US$184 billion globally in revenues in 2023 [2]. The mobile platform generated the largest market share of 49% and contributed an income of US$90.5 billion. The prevalence of mobile platforms in the video game industry is justifiable given the growing user base, advancing mobile technology, and convenience and mobility [3–5].

Amidst the COVID-19 pandemic, there was a notable surge in the engagement of video games, with an average rise of up to 52% or 8.5 h weekly [6, 7]. Many people utilize games to enhance their well-being, social and cognitive stimulation, and stress relief in response to restrictions at that time [8, 9]. This gaming industry also had a substantial 20% increase in total revenue by the end of 2020, as reported by the International Data Corporation (IDC), compared to the previous year [10]. However, it is unclear if this increase in income is attributed to existing users or new users who recently began adopting video games amid the COVID-19 pandemic.

The behaviors developed while playing video games during the COVID-19 pandemic may persist in the short or long term [11, 12]. Nevertheless, while examining the revenue amounts of mobile game platforms for the conclusion of 2022, it is evident that there has been a 6% deceleration compared to the preceding year [13, 14]. Therefore, developers must exert endeavors to augment the user base, as it is from this demographic that developers derive their revenue.

The number of active mobile gaming users in Indonesia has been increasing yearly. It is reported that there were 64.1 million active users in 2022 [15]. However, these 64.1 million represent less than 30% of Indonesia's population for the same year [16]. This statistic indicates that Indonesia, the fourth most populated country globally, has a highly accessible mobile gaming market. Hence, studying the Indonesian mobile gaming market is crucial. Developers must exploit possibilities to expand their market share in Indonesia since users are a key source of revenue.

Previous studies have unveiled several determinants that impact an individual's decision to adopt a mobile game application, including in Indonesia. Structural Equation Modeling (SEM) was employed to examine if its usefulness and convenience influence the adoption of a mobile gaming application [17, 18]. Yet, several studies have also indicated that the quality of the games provided is crucial in motivating individuals to adopt mobile gaming [19–21]. In addition to the intrinsic parts of the game, Nam and Kim [22] also discovered that the time leading up to the game's release and the immediate aftermath is critical for developers to draw many users promptly.

Manuscript received August 9, 2024; revised September 3, 2024; accepted October 8, 2024; published January 23, 2025.

Prior studies have aimed to capture the current state of the user's behavior in the mobile gaming industry. These studies offer insights into existing user behavior for developers to consider while acquiring new users. However, it is imperative to anticipate future outcomes accurately to make an informed decision in managing a particular business [23]. Developers require technology capable of forecasting future conditions in the mobile gaming business based on future strategic intentions. Lyneis [23] suggested employing System Dynamics (SD) as a dependable approach for forecasting due to its capacity to comprehend and watch system activity dynamically throughout time [24]. Researchers have widely utilized SD as a finance [25–27], e-commerce [28], education [29], mobile banking [25, 30], supply chain [31], tourism [32], and transportation [33] decision-making tool. The researchers demonstrated that SD is an effective tool for making decisions that involve future forecasts due to its ability to simulate the policy scenarios we create.

To the best of our knowledge, no study provides a comprehensive understanding of the current status of adopting systems for new mobile game users. Furthermore, no study offers developers guidance on how to enhance the effectiveness of these systems. The current study aims to fill gaps and provide significant contributions. First, this study expands current research on user behavior in the adoption of mobile gaming. This study explores the interrelated variables that have led to the current situation by analyzing the influencing variables from the user's perspective and thoroughly assessing the current condition of the mobile gaming industry. Second, this study examines present conditions in the mobile game industry and offers insights into future strategies developers may employ to enhance system performance and boost mobile game acquisition rates. Hence, this study utilizes the SD method to provide developers with a comprehensive understanding of the system's present state, particularly regarding acquiring new mobile game users. SD could gain this edge by utilizing models calibrated with previous data to estimate future user numbers. Moreover, by examining potential scenarios for acquiring new users, SD models might provide valuable insights into suitable future strategies for enhancing system performance. As a result, the SD models help developers better understand the specific actions required to acquire new users successfully.

This paper is structured as follows: it begins with a review of previous related work, followed by the SD model. It concludes with a demonstration of scenario planning for the next 12 years and its evaluation. Finally, the discussion, the conclusion, and the need for further work are stated.

II. Literature Review

The rapid development of smartphone technology boosted internet advancements and led to innovative products designed for mobile devices [34, 35]. Another product that saw significant growth during that period was mobile gaming. Liu and Li [34] point out that mobile game acquisition rates vary throughout different countries. There is concern that the mobile gaming business may decline in popularity, similar to mobile TV products that failed to attract users. Nam and Kim [22] argue that the time before and immediately after a mobile game's release is critical for developers to attract many users.

These users are crucial for the business since developers rely on them to generate revenue. According to the Acquisition-Retention-Monetization (ARM) Funnel life cycle model, developers must progress through the user acquisition phase before advancing to monetization [36]. Fig. 1 illustrates the ARM Funnel, which consists of three phases: acquisition, retention, and monetization. These stages will cycle as developers reinvest their revenue to gain additional users.

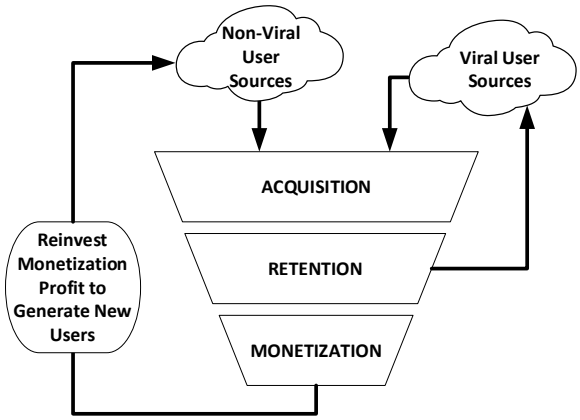


Fig. 1. The ARM funnel.

The ARM Funnel concept illustrates that revenue is achievable solely through a subset of users who persist in using the application. The number of remaining users diminishes compared to the number of new users successfully gained initially. Zhou [37] emphasized thus the importance of developers understanding the necessary preparations to boost the acquisition rate of mobile games, as it is a crucial component for user acquisition success. The more users the developers acquire, the higher the potential revenue during monetization.

On the other hand, mobile applications, particularly games, are predominantly available in a freemium model, allowing users to use them without spending money. Consequently, developers face significant obstacles to successfully monetizing their products. Users are likely to abandon an application and transition to similar alternatives if they perceive that the program fails to deliver a satisfactory experience [38–41]. Therefore, developers must present distinctive characteristics or other special features that attract potential users' interest in adopting the application [42, 43].

Ease of use significantly influenced mobile gaming adoption [17, 18, 37]. Ease of use can enhance the game's flow, leading to an enjoyable user experience. Subsequent investigations also support this finding. Cota *et al.* [44] discovered that seniors prefer Casual genre mobile games since they are simple to play and do not demand much effort. This finding aligns with other research indicating

that seniors hesitate to engage in gaming due to time constraints [45].

However, experienced mobile device users do not view ease as an influence for adopting mobile gaming [34, 46]. Users are accustomed to using an application on a mobile device; therefore, they should have no trouble navigating a mobile gaming application. Cai *et al.* [47] discovered that users lacked interest in mobile games with traditional themes when the developers simplified the mobile adaptation of traditional games. Users notice a decline in experience when the mobile adaptation of a traditional game is simplified compared to the original version.

Research on adolescents revealed that they initiated using mobile games during periods of stress and exhaustion [48]. Parents and elders utilize smartphone games to enhance their quality of life and mental well-being, as per their explanations [21, 44]. The findings confirm prior assertions that mobile gaming applications may be successful if they deliver benefits, pleasurable experiences, and game flow [17, 18, 49, 50]. It is essential to remember that the game flow presented also requires a balance between the difficulties users face. An imbalance between the skill level of users and the challenges presented in the game can be perceived as boring and unpleasant, leading users to abandon the game in favor of others [38, 51]. Therefore, the mobile game's quality is critical for it to be beneficial and enjoyable and could be adopted by users [19, 37].

Most previous studies used statistical tools like SEM or Analysis of Variance (ANOVA) to validate their hypothesis model. Some individuals utilize an alternative methodology of qualitative research through interviews. The studies were conducted to provide an overview of user behavior in mobile game adoption. However, Lyneis [23] argues that business executives must understand the present system behavior and anticipate future scenarios to make informed business decisions. Business executives need to forecast what will happen in the future.

Lyneis [23] examined the application of System Dynamics (SD) models to predict system behavior. He argued that the structural orientation of SD models offers more precise representations of short and mid-term behavior compared to statistical models. System dynamics use simulation to study society's intricate economic system and address decision-making challenges in business, industry, and the economy [52].

SD has effectively evolved into a corporate sector investment and finance decision-making tool filled with uncertainty [25–27]. Suryani *et al.* [31] demonstrated using SD to aid decision-making regarding air cargo demand predictions and terminal capacity planning. Yan *et al.* [28] utilized SD to determine the future path of e-commerce application development policy. Li *et al.* [32] use SD to forecast chances for boosting tourist business in the face of the COVID-19 pandemic. Shen *et al.* [33] also utilized SD to develop strategic planning for the future development of transportation in China. Meanwhile, Zhu *et al.* [53] use the methodology of SD to regulate and manage the release of emissions resulting from economic expansion in China.

III. Methodology

This study employs the SD framework to enhance existing studies on user behavior around mobile game adoption. This study utilizes the SD framework to analyze current conditions in the mobile game industry and provides insights into future strategies that developers may adopt to improve system performance and increase mobile game acquisition rates.

SD models are well-suited for analyzing intricate systems through detailed and quantitative simulations, leading to more dependable and robust results [54]. In contrast to other models, the SD utilized in this study is more effective in tackling the following issues. First, the various factors influence the acquisition of mobile game users, which may include complex influencing mechanisms. Causal Loop Diagrams (CLD) may address many causal relationships concerning mobile game adoption, growth of smartphone users, game quality, churn, and developers' attempts to attract new players. Second, the abovementioned causalities are complex and nonlinear, intricately linked to many policies, complicating the modeling process. SD models can simulate a complicated nonlinear system with different policies dynamically. It is very flexible for performing policy scenario studies. The research methodology in this study is illustrated in the diagram in Fig. 2 below.

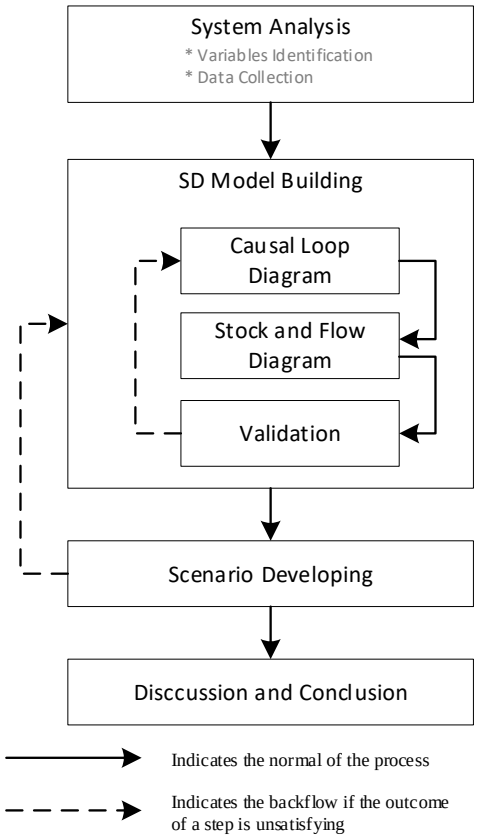


Fig. 2. Research methodology.

The approach of this study, as seen in Fig. 2, proceeds with a review of existing literature to identify variables related to the mobile game adoption system and the

relationships among these variables. Following the identification of the variables, activities will proceed to acquire historical data on the key variables. The validation step will use this data to determine whether the base model is valid.

Upon successfully validating the developed base model, scenario generation can derive optimal policies to enhance system performance for mobile gaming user acquisition. Any assumptions used for scenario development will be further explained in the Scenario Planning section below. This study will conclude with a discussion of the conclusions of the findings during this research process.

A. Data Collection

The SD method initiates by developing a base model representing the system's current state. To determine whether the model created reflects the system it represents, validation needs to be carried out by comparing the data generated from the simulation results with historical data in the real world. The historical data is from the key variables of this system, precisely the number of active mobile gaming users from 2011 to 2022 obtained from Statista [15].

B. Validation

The validation process for the model involves comparing its behavior with that of the actual system. The validation procedure can be achieved by calibrating the simulation results with historical data. Model validation can be achieved by two statistical tests: the mean comparison test and the error variance comparison test [55]. The mean comparison is defined in Eqs. (1)–(3), and the error variance is defined in Eqs. (4)–(6).

$$Mean\ comparison = \frac{|\bar{S} - \bar{A}|}{\bar{A}} \quad (1)$$

where:

$$\bar{S} = \frac{1}{n} \sum_{i=1}^{n} S_i \quad (2)$$

$$\bar{A} = \frac{1}{n} \sum_{i=1}^{n} A_i \quad (3)$$

$$Error\ Variance = \frac{|S_S - S_A|}{S_A} \quad (4)$$

where:

$$S_S = \sqrt{\frac{\sum_{i=1}^{n} (S_i - \bar{S})^2}{n-1}} \quad (5)$$

$$S_A = \sqrt{\frac{\sum_{i=1}^{n} (A_i - \bar{A})^2}{n-1}} \quad (6)$$

IV. System Dynamics Model

A. Causal Loop Diagram

A Causal Loop Diagram (CLD) illustrates a comprehensive framework and shows causal connections between variables. This study constructs a framework using current literature to establish causal relationships among variables that impact the acquisition system of mobile game users in Fig. 3. The CLD indicates the relationship among variables, namely potential users—those who have mobile devices but are not yet active users of mobile games, the adoption, the growth of potential users, active users of the mobile games, churn, intention to play, perceive of enjoyment, playing engagement, switching intention, total revenue, and advertising spending by developers.

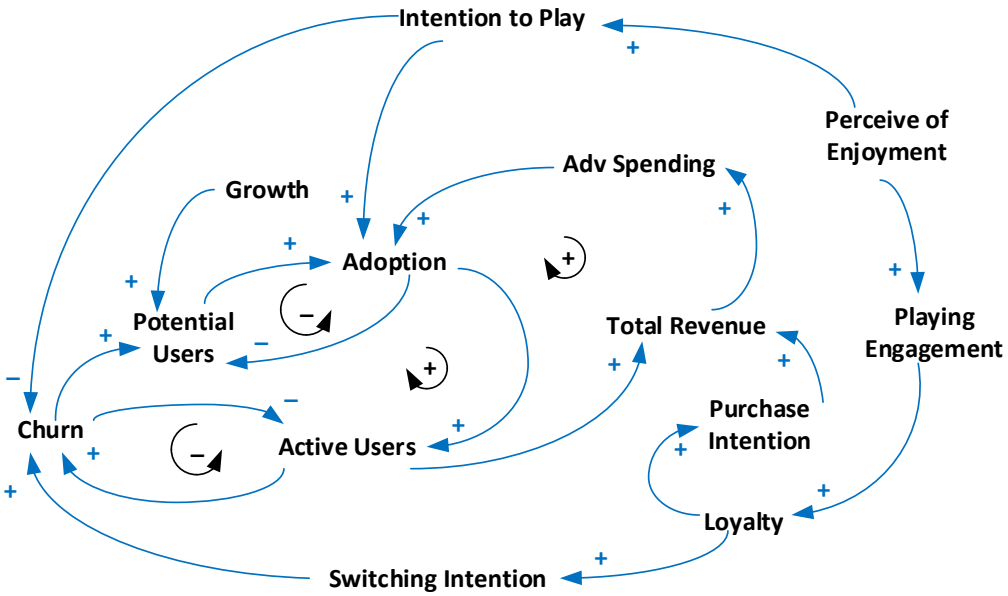


Fig. 3. CLD for mobile game user acquisition.

The CLD model consists of many feedback loops that interact among the variables. More specifically, the model has two balancing loops and two reinforcing loops. First, those who become active players of mobile games must have a mobile device. These mobile device owners are called potential users because they have the potential to be converted into active users by adopting mobile games. That is why, as the number of potential users increases, so does the adoption level, resulting in an enormous number of active users of mobile games. However, this also increases the churn rate, which may revert the users' status to potential users. The potential users themselves are those who use smartphones but have not yet adopted mobile games. It is necessary to possess a smartphone to actively engage with mobile games, as these games are designed to be played on mobile devices [56, 57]. Second, raising the number of active users will create more revenue for the developer, prompting them to invest more in advertising to boost adoption and attract more active users. Third, as the number of potential users increases, the adoption level will rise, but simultaneously, the number of potential users will drop. Fourth, higher user activity increases the likelihood of churn, whereas the churn rate reduces the number of active users.

The CLD highlights the feedback structure of a system but is never exhaustive [31]. We need to transform the causal loop diagram into a flow diagram that highlights the physical structure of the model. It tends to be more complex than a CLD, prompting us to think more precisely about the system's structure.

B. Base Model of Mobile Games User Acquisition

The Stock and Flow Diagram (SFD) was developed according to the CLD above Fig. 3. This SFD becomes the base model before we create some scenarios to enhance the system's performance. As shown in Fig. 4, the Active Users variable is classified as a level variable that accumulates the Adoption and decreases by Churn see Eq. (7).

$$Active\ Users\ (t) = Active\ Users\ (t - dt) + (Adoption\ (t) - Churn\ (t)) \times dt \quad (7)$$

The Adoption itself is generated by accumulating several other variables such as potential growth, intention to play, retention rate, CPI, adv spending, growth, and churn see Eq. (8). Potential Users are also classified as a level variable that accumulates the Growth and Churn but decreases by Adoption see Eq. (9).

$$Adoption\ (t) = (Adoption\ Rate \times Intention\ to\ Play\ (t) \times Potential\ User\ (t)) + (Retention\ Rate \times (Adv\ Spending\ (t)/CPI\ (t)) \times (Growth\ (t) + Churn\ (t))) \quad (8)$$

$$Potential\ Users\ (t) = Potential\ Users\ (t - dt) + (Growth\ (t) + Churn\ (t) - Adoption\ (t)) \times dt \quad (9)$$

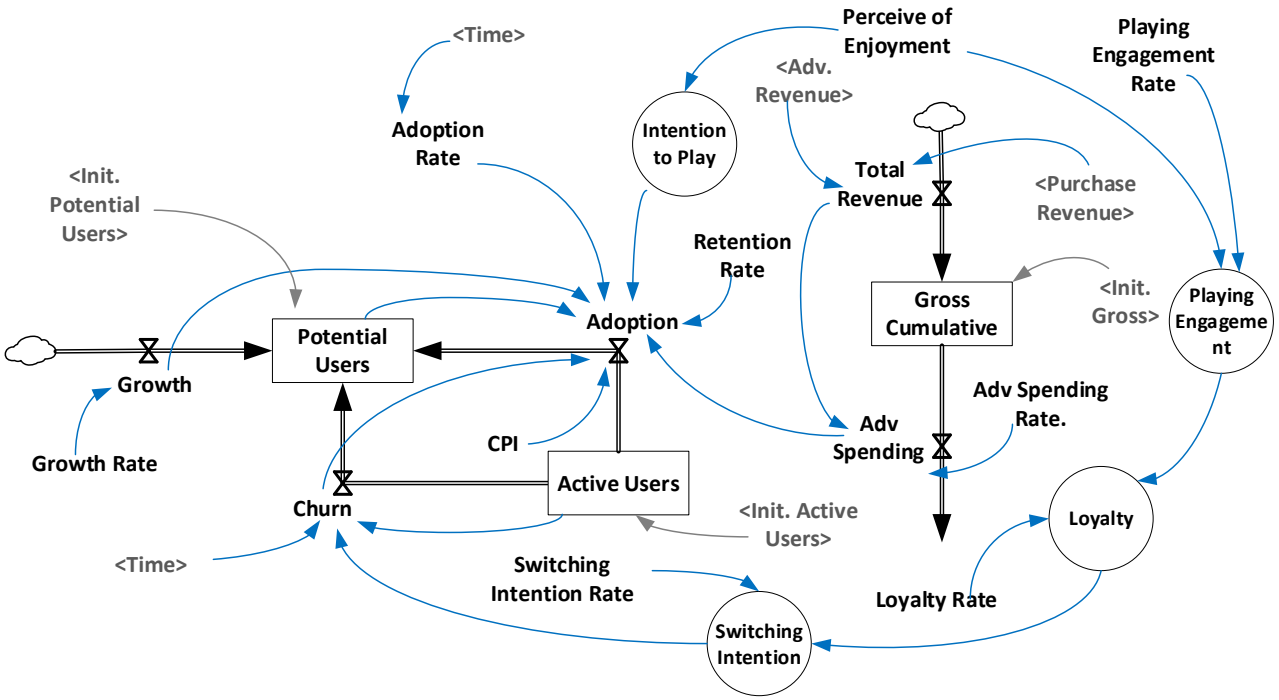


Fig. 4. Flow diagram for mobile game user acquisition based on existing condition.

C. Model Simulation Result and Validation

The model simulation spans a time horizon of 12 years, from 2011 to 2022, with yearly intervals. This time frame was selected because 2011 noted the resurgence of the Android smartphone platform, which is now one of the most popular in the market. Android's market share surpassed iOS in the 4th quarter of 2010 [58]. Since 2011,

the popularity of mobile games has grown, allowing more mobile device users to access them. The base model simulation must be validated to confirm its resemblance to real-world settings. The model can be declared valid if the mean comparison is below 5% and the error variance is under 30% [55]. The simulation yielded an average of 34.6476 Active Users ($\bar{S}$), while historical data shows an average of 34.6166 active users ($\bar{A}$), as seen in Table I. The standard deviation of the simulated results for Active Users is 18.8722 (S_s). Meanwhile, the historical data from Active Users indicates that the standard deviation is 19.8317 (S_A). The mean comparison has been defined above in Eqs. (1)–(3), and the error variance has been defined above in Eqs. (4)–(6).

TABLE I. SIMULATION RESULT AND HISTORICAL DATA OF ACTIVE USERS BETWEEN 2011 AND 2022

SA	Average (in million)	Standard Deviation
Simulation Result (S)	34.6476	18.8722
Historical Data (A)	34.6166	19.8317

According to these results, we may establish the mean comparison, and the error variance as follows:

$$\textit{Mean comparison of Active Users} = \frac{|34.6476 - 34.6166|}{34.6166} = 0.0009$$

$$\textit{Error variance of Active Users} = \frac{|18.8722 - 19.8317|}{19.8317} = 0.0484$$

The mean comparison of Active Users is less than 5%, and the error variance is less than 30%, indicating the validity of our model based on the result provided above. Fig. 5 displays the contrast between the simulation results and historical data of Active Users from 2011 to 2022.

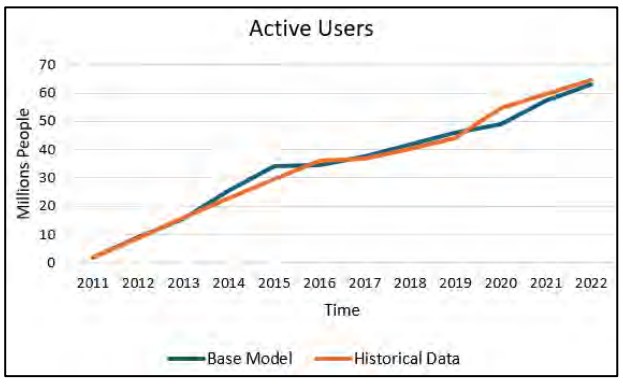


Fig. 5. Graph of active users between simulation result and historical data.

V. SCENARIOS PLANNING

Scenario is a technique used to create a collection of narratives that may potentially occur in the future. Nevertheless, considering the degree of certainty, we can categorize it into optimistic scenarios, which are anticipated to happen in the future with complete optimism, and pessimistic scenarios, which consider unfavorable circumstances that impede the realization of optimistic scenarios. Various alternative scenarios can be generated from a valid model by incorporating additional feedback loops, introducing new parameters, modifying the structure of the feedback loops (structure scenario), or adjusting the parameter value to observe its influence on other variables (parameter scenario). This study included structural scenarios with parameter scenarios to enhance the robustness of sensitivity analysis (Fig. 6). We established a 12-year time horizon for the scenario model, considering the system's learning tendency.

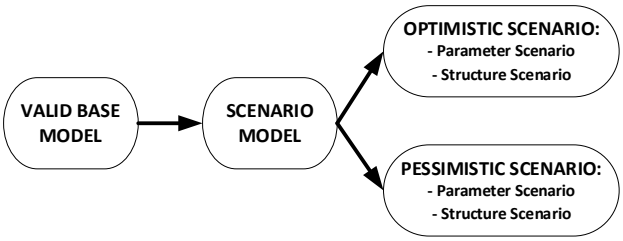


Fig. 6. Scenarios block diagram.

A. Optimistic Scenario

This optimistic scenario covers two types of scenarios: the optimistic parameter scenario and the optimistic structure scenario. We modify the parameter values based on a particular assumption. Our attention is on the growth rate parameter for potential users. Historical data shows that Indonesia gained 17.78 million potential smartphone users by the end of 2020 compared to 2019, with 2020 being the year the COVID-19 pandemic began. Based on the circumstances, it is assumed that the rise of potential users follows a normal distribution, reaching an average of 17.78 million people. Former researchers believe that behaviors formed during the pandemic may persist for an extended period, which leads us to be optimistic that the trend of digitalization among the public will last into the future [11, 12, 59]. The growth rate of potential users directly impacts the quantity of potential users. Thus, under the optimistic parameter scenario, the annual growth rate of potential users starting in 2023 will be adjusted to 17.78 million people. In Fig. 7, this parameter change will occur in the Growth Rate opt scn.

For the optimistic structure scenario, we include five new variables in the scenario model (Fig. 7). The five variables are Advertising Campaign opt scn, Word-of-Mouth (WOM) opt scn, Product Awareness opt scn, Ratings opt scn, and Customer Relations opt scn. These five extra variables are included based on the literature reviews indicating their potential impact on customer behavior when adopting something new (see Table II). We argue that these five new variables can optimistically enhance system performance, particularly with increased active users.

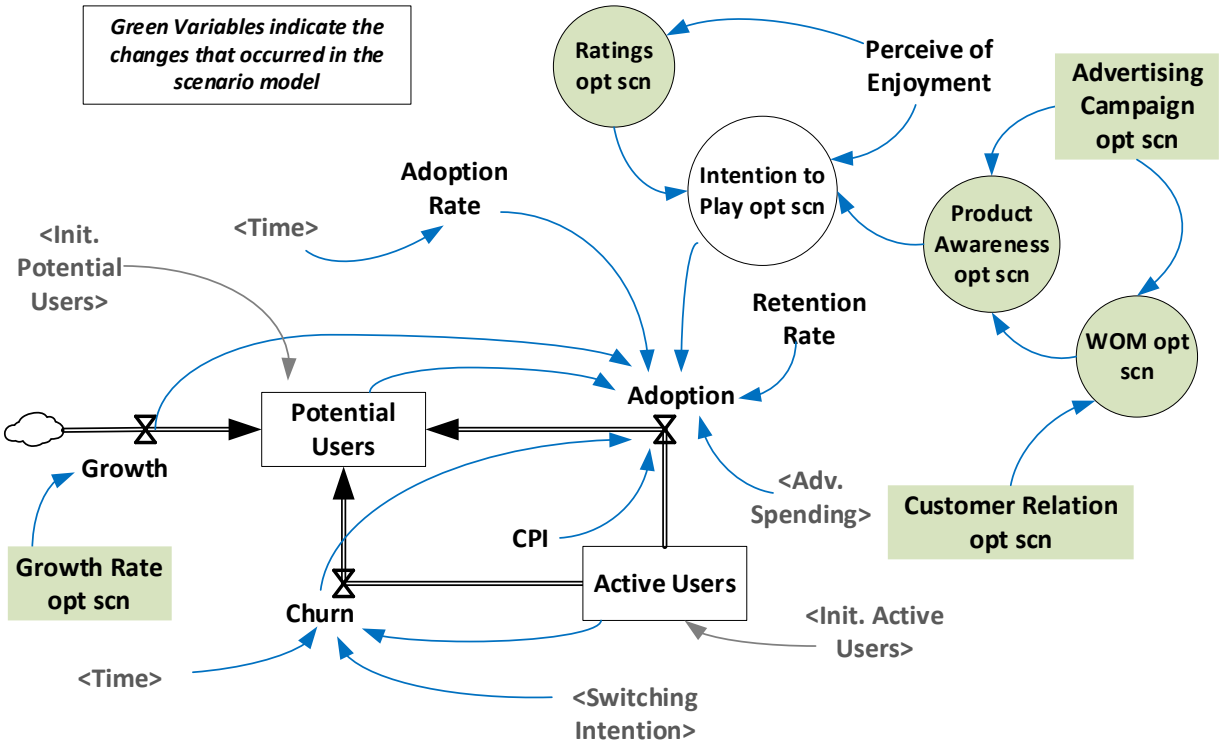


Fig. 7. Flow diagram of mobile game user acquisition optimistic scenario.

1) Advertising campaign

Nam and Kim [22] stress the crucial need for mobile game creators to acquire consumers promptly upon launching the mobile game application. Aleem *et al.* [60] also argue that digital product developers have a little window of time after their launch before competitors attract their users. The focus is strategically timing adverts to enhance user awareness of the new game. According to Gong *et al.* [61], there is a positive correlation between the investment value of advertising and the number of downloads of gaming applications. Sama [62] also demonstrates that advertising can impact customer behavior. Aryun *et al.* [63] found that more exposure to advertising for mobile games leads to greater awareness of the game product and a higher likelihood of downloading the game.

Kreissl *et al.* [64] found that influencers have the capacity to alter societal culture about how people might derive enjoyment from games. Hakim and Indarwati [65] also found that advertising, particularly through influencers, might positively impact Indonesian mobile game users' inclination to make in-app purchases. Hence, developers might employ this method to encourage potential users to embrace their application. Developers may leverage the presence of these influencers to promote the games they create.

2) Word of Mouth (WOM)

WOM has been demonstrated to be a contributing element in boosting the uptake of a game [61]. According to several studies, WOM influences purchase intentions for many products, including mobile games [22, 66–69]. The dissemination of WOM via social media is thought to enhance product awareness and boost sales value. This sales value increment also pertains to items offered in non-traditional markets. Lee *et al.* [67] demonstrated that WOM can boost the sales of mobile gaming apps that involve electronic transactions.

One of the excellent advertising mediums is YouTube since it facilitates user information diffusion through its comment-sharing function. Google's study revealed that 95% of gaming users were connected to viewing YouTube [70]. Hence, developers are also encouraged to promote their application on YouTube using influencers to stimulate WOM marketing.

3) Product awareness

Aleem *et al.* [60] and Aryun *et al.* [63] asserted that showcasing ads, such as in mobile games, increases user awareness of the product's presence. Sama [62] demonstrates that advertising through television or the Internet significantly enhances customer knowledge of a product's existence. In addition, product awareness among users may be increased by WOM [66, 68, 69]. This user awareness aims to stimulate user interest in adopting the product by promoting engagement in familiar games through advertising or WOM.

4) Ratings

Rutz *et al.* [71] discovered a positive correlation between the frequency of usage of mobile game applications and the ratings they received. High rating reflects the product's quality. Ratings can impact other users' decisions on whether to continue using the application [35, 72]. In addition, Nam and Kim [22] demonstrate that high ratings are necessary to generate interest from potential users and encourage them to adopt the game.

5) Customer relation

Godes and Mayzlin [66] highlight a sales-boosting method that involves building connections with customers and engaging with them. The communication process aims to create a positive view of the product's worth, leading users to engage in WOM promotion. Consumers will be inclined to purchase a product with good value. Nam and Kim [22] conducted a study supporting the idea that post-adoption contacts established by developers lead to word-of-mouth advertising, resulting in increased sales value.

TABLE II. ADDITIONAL VARIABLES FOR STRUCTURE SCENARIO

Variable	Definition	Source
Advertising Campaign	The developer's campaign aims to introduce its product.	Nam and Kim [22], Aleem *et al.* [60], Gong *et al.* [61], Sama [62], Aryun *et al.* [63]
WOM	The involvement of users in introducing a product through the dissemination of information through oral communication.	Nam and Kim [22], Gong *et al.* [61]
Product Awareness	Consumer awareness of a product's existence.	Aleem *et al.* [60], Sama [62], Aryun *et al.* [63], Godes and Mayzlin [66], Li and Wu [68], Vidyanata [69]
Ratings	User evaluation of a product on a marketplace platform.	Nam and Kim [22], Zolkepli *et al.* [35], Rutz *et al.* [71], Sun [72]
Customer Relation	The relationship between developers and users.	Nam and Kim [22], Godes and Mayzlin [66]

The five additional variables mentioned above will raise the Intention to Play. Apart from Perceive of Enjoyment, ratings of a game will also affect Intention to Play shown as the variable Rating opt SCN in Fig. 7. Along with Ratings opt scn, Intention to Play is also scenarized to have a beneficial impact from one of the new variables, namely Product Awareness opt scn. Furthermore, WOM opt scn and Advertising Campaign opt scn will help Product Awareness opt scn to have a favorable impact.

B. Pessimistic Scenario

This pessimistic scenario also covers two types of scenarios: the pessimistic parameter scenario and the pessimistic structure scenario. For the pessimistic parameter scenario, we presume a deceleration in the growth rate of potential users will occur in the coming years. The historical statistics on the growth of potential users in Indonesia from 2011 to 2022 indicate that the slightest increase happened in 2022, with only 11.27 million people per year. According to the International Data Corporation (IDC), smartphone sales in Indonesia are estimated to decrease by 14.3% in 2022 [73]. The reduction was global and was caused by delays in the delivery of raw materials for smartphone manufacture owing to the present global scenario. This pessimistic parameter scenario anticipates a minimum of 11.27 million people per year as a reference for potential mobile gaming user growth in Indonesia once the hurdle persists in the future. In Fig. 8, this parameter change will occur in the Growth Rate pess scn.

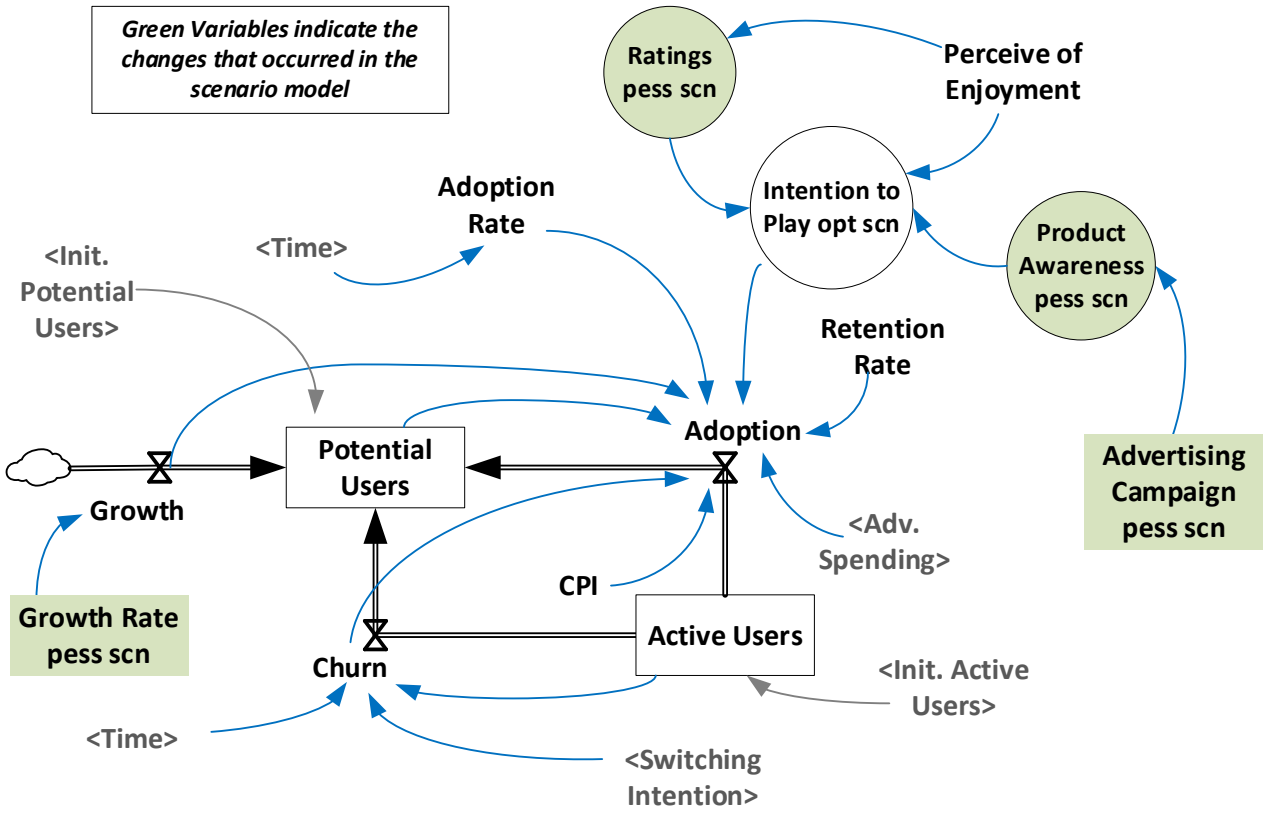


Fig. 8. Flow diagram of mobile game user acquisition pessimistic scenario.

In the pessimistic structure scenario, the developer is expected to rely on a strategy of advertising using the Advertising Campaign pess scn variable to create Product Awareness pess scn and subsequently influence Intention to Play pess scn (Fig. 8). In contrast to the optimistic scenario, in this pessimistic scenario, the advertisements conducted by this developer are projected not to attract much interest from influencers, resulting in a lack of word-of-mouth influence if the developer does not have enough appeal or is not from a wide recognized brand [65]. We are pessimistic that developers will have sufficient finances for sponsored advertising efforts; thus, they will likely depend more on self-managed social media to promote their products. Consequently, the WOM and Customer Relations variables will be excluded from this scenario.

Though Product Awareness pess scn has a different model structure from the Optimistic Structure scenario model, Intention to Play is still in the scenario that it will gain a positive influence from the additional variables of Ratings pess scn and Product Awareness pess scn. Fig. 8 shows that since we exclude the WOM and Customer Relation variables in this model, Product Awareness pess scn will only be expected to get an influence from Advertising Campaign pess scn.

C. Scenario Summary

This section presents a summary of the optimistic and pessimistic scenarios. This summary can be seen in Table III below.

TABLE III. SUMMARY OF THE SCENARIOS

	Optimistic Scenario	Pessimistic Scenario
Parameter Scenario	Growth Rate of Potential Users is projected to be 17.78 million people annually based on the belief of the sustained rise in smartphone ownership in Indonesia following the COVID-19 pandemic	Growth Rate of Potential Users is projected to be 11.27 million people annually based on the assumption that global smartphone sales will diminish due to supply limitations on smartphone raw materials.
Structure Scenario	The scenario model has five additional variables: Advertising Campaigns, WOM, Product Awareness, Ratings, and Customer Relations. These five extra variables are included based on the belief that they have a potential impact on customer behavior when adopting something new, as well as the potential to affect an individual's intention to adopt a mobile game.	This pessimistic scenario includes only Advertising Campaigns, Product Awareness and Ratings, but excludes the variables WOM and Customer Relations. The removal of WOM and Customer Relations variables comes from skepticism regarding developers' willingness to engage in costly advertising campaigns with influencers, which could diminish the benefit of WOM activities among potential users.

VI. RESULT AND DISCCUSSION

The following section will present the simulation results of the scenarios constructed and validate them using the ANOVA statistical tool. This section presents theoretical contributions and management implications to enhance the understanding of strategies aimed at boosting the active user base of mobile games, particularly in Indonesia.

A. Scenario Smulation Result

This study examined four scenario combinations to see which scenario most effectively enhances the number of active users:

1. A combination of Optimistic Structure Scenario and Optimistic Parameter Scenario
2. A combination of Optimistic Structure Scenario and Pessimistic Parameter Scenario
3. A combination of Pessimistic Structure Scenario and Optimistic Parameter Scenario
4. A combination of Pessimistic Structure Scenario and Pessimistic Parameter Scenario

Fig. 9 illustrates the rise of Active Users in an optimistic structure scenario (combination of number 1 and 2) from the year 2023 to 2034. Fig. 10 displays the growth graph of Active Users in the pessimistic structure scenario (combination of number 3 and 4) from year 2023 to 2034.

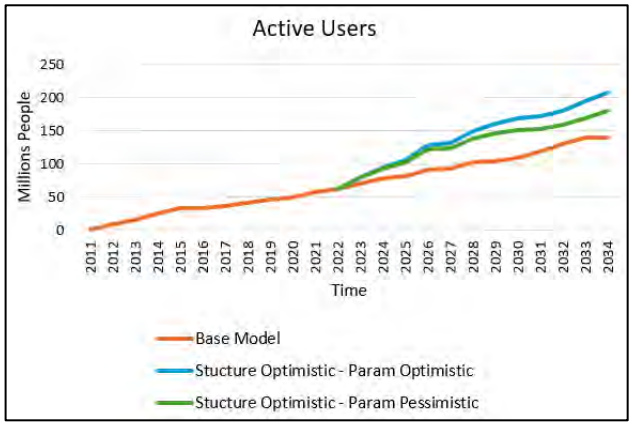


Fig. 9. Simulation result based on optimistic structure scenario.

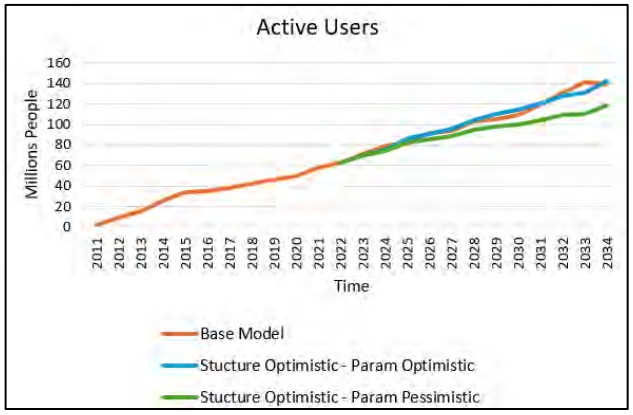


Fig. 10. Simulation result based on pessimistic structure scenario.

Figs. 9 and 10 also display graphs from the base model that were re-simulated with an extended time horizon from the year 2023 to the year 2034, similar to the scenario models. Nevertheless, we did not alter the model structure or parameter values in the base model. This way, we can determine whether our developed scenarios yield better results than the base model. The scenario combinations

that exceed the average value of the base model on average are:

1. Optimistic Structure Scenario and Optimistic Parameter Scenario
2. Optimistic Structure Scenario and Pessimistic Parameter Scenario
3. Pessimistic Structure Scenario and Optimistic Parameter Scenario

The average number of *Active Users* from the year 2023 to the year 2034 is 105.45 million people in the base model. By the end of the scenario simulation last year, 2034, the base model's total active users reached 139.68 million. From the scenario findings in Fig. 9, it is clear that the combination of the Optimistic Structure Scenario and the Optimistic Parameter Scenario will generate 208.42 million people of active users by 2034. This scenario's average between 2023–2034 shows 148.30 million active users annually. This success exceeds the average of the active users produced by the base model in the same period by 40.64%. Still, Fig. 8 shows that the combination of the Optimistic Structure Scenario and the Pessimistic Parameter Scenario generates 179.86 million active users by 2034, and the average is 135.04 million active users annually, or 28.06% more than the base model.

Fig. 10 shows that combining the Pessimistic Structure Scenario and the Optimistic Parameter Scenario generates 142.39 million active users by 2034. Regretfully, this combination's average number of active users is only 105.80 million annually or just a 0.33% increase from the base model. We excluded the combination scenario of the Pessimistic Structure Scenario and Pessimistic Parameter Scenario because its average value is inferior to the base model's average value, where the average value is only 94.74 million. This excluded combination scenario is impractical as it leads to worsened system performance.

B. ANOVA Validation

One-way ANOVA is a statistical method used to perform comparisons. This ANOVA approach allows for comparing variance values among three or more groups of data [74, 75]. According to the simulation findings, three sets of Active Users data are derived from 3 scenarios. For this reason, we want to compare the values from these three groups of scenario data with the data from the base model as the control group. This comparison aims to determine if the value gained from applying scenarios to the model significantly differs from that of the base model.

We utilize RStudio for conducting ANOVA computations. We address the following hypothesis, while Table IV shows the result.

TABLE IV. ANOVA TEST RESULT

	Df	Sum Sq	Mean Sq	F value	*p* value
Scenario	3	16647	5549	6.111	0.00144
Residuals	44	39950	908		

H_0: The scenario data shows no significant differences
H_1: The scenario data shows significant differences

The ANOVA test findings indicate three data groups as the Degrees of Freedom (DF1) or numerator compared to a data group as the control group. There are now 44 DF2 or denumerators. The computation returns a *p*-value of 0.00144, less than 0.05, based on an F value of 6.111. The p-value falls between 0.01 and 0.001, indicating we may reject the null hypothesis. This result suggests that the simulation results for this scenario indicate significant differences compared to the base model data.

C. Post Hoc Pairwise T-Test

Testing will proceed with a post-hoc test, specifically the post-hoc pairwise t-test. Conducting this Post Hoc Test will allow us to identify the data group that exhibits the most significant differences compared to the control group. Table V below shows the result of the Post Hoc Pairwise T-Test.

TABLE V. THE P-VALUE OF POST HOC PAIRWISE T TEST RESULT

	base model	Scenario 1	Scenario 2
Scenario 1	0.0037	-	-
Scenario 2	0.0328	0.3442	-
Scenario 3	0.9777	0.0037	0.0328

Scenario 1: The combination of an optimistic structure and an optimistic parameter scenario
Scenario 2: The combination of an optimistic structure and a pessimistic parameter scenario
Scenario 3: The combination of a pessimistic structure and an optimistic parameter scenario

The Post Hoc Pairwise T-Test findings indicate that the combination of the optimistic structure scenario with the optimistic parameter scenario has a statistically significant *p*-value of 0.0037 compared to the base model as the control group and the second scenario with a *p*-value of 0.0328. Both scenario groups reject the null hypothesis (H_0) since its *p*-value is less than 0.05, indicating a significant difference compared to the base model group. The third scenario has a *p*-value of 0.9777 and is higher than 0.05. The third scenario indicates that the data group is not significantly different from the base model group, and it is not feasible for implementation since it does not substantially improve system performance.

The One-Way ANOVA test relies on the assumptions of normal distribution of variables and homogeneous variance among data groups. If the specified assumptions are satisfied, the outcomes of the ANOVA test and the Post Hoc Pairwise T-test can be deemed valid. The Shapiro-Wilk test is employed for the normality test, whereas the Levene Test is used for testing homogenous variance. The Shapiro-Wilk test generates a *p*-value of 0.8411, and the Levene Test produces a *p*-value of 0.1466. Both results indicate a value higher than 0.05, suggesting the acceptance of the null hypothesis, meaning that the data group is normally distributed and homogenous.

D. Contributions

This study has modeled a mobile game user acquisition system utilizing the SD Framework. The intention factor significantly affects the transition from potential users to active mobile game users [17, 18, 46], represented by the Intention to Play in the model. Consequently, to formulate strategic policies for developers to boost the number of active users, this study constructed scenarios focused on strengthening user intention.

A total of four scenario combinations were simulated in this study. The four combinations are generated from two types of scenarios, namely structure scenarios and parameter scenarios [55], and each is divided into optimistic and pessimistic categories. The structure scenario focuses more on internal efforts that developers can make to improve system performance. The parameter scenario is more produced by external conditions that affect system performance, such as the growth rate of potential users.

The first scenario combination, combining an optimistic structure scenario and an optimistic parameter scenario, yields more favorable outcomes than other scenario combinations. This finding indicates that developers must seriously pursue enhancing system performance while simultaneously being dependent upon the success of external entities in expanding mobile device sales.

Nonetheless, examining the simulation results from the Optimistic Structure Scenario reveals that the output generated with a rising number of active users exceeds the output from the Pessimistic Structure Scenario. Following the assumptions in the Pessimistic Structure Scenario, this scenario excludes WOM and Customer Relations variables. Product awareness is inferior to that in the Optimistic Structure Scenario, lacking supportive factors such as WOM or customer relations. This result aligns with prior research indicating that the interaction between users and developers can enhance WOM enthusiasm [66]. This WOM activity will generate Product Awareness, enhancing product uptake [61].

The COVID-19 pandemic, which began in 2020, significantly increased global mobile device users. We may anticipate that this upward trend will persist as the substantial growth rate of potential users has demonstrated its capacity to increase active users [11, 12, 59]. The simulation results of the scenario model illustrate this clearly. We can compare the combination of the first scenario with that of the second scenario. Furthermore, we can also compare the combination of the third and fourth scenarios. Regardless of the structured scenario—optimistic or pessimistic—when combined with an optimistic parameter scenario, the outcome proves a more significant rise in the number of active users compared to the pessimistic parameter scenario.

Based on the findings from the simulation results above, below we present theoretical contributions and managerial implications:

1) Theoretical contributions

This study contributes to the existing literature on mobile game adoption systems. First, by using the SD framework, this study has been able to describe the current system situation and to project the situation in the future prior to decision-making [23]. Second, in order to produce appropriate policies to increase the number of active mobile game users in the future, this study has designed scenarios that developers can apply in the real world. There are two types of scenarios, namely scenario structure and scenario parameters, and they are divided again according to certain assumptions regarding the level of confidence in the realization of this scenario, namely optimistic scenarios and pessimistic scenarios [55]. Third, the findings of this study suggest that enhancing system performance can be achieved by prioritizing the intention to utilize the mobile game, hence stimulating adoption rates and boosting the number of active mobile game users [17, 18, 46].

2) Managerial implications

The results of this study provide valuable contributions to mobile game developers. The proposed simulation model allows developers to observe the interconnections and mutual influences among the system's variables. Furthermore, the simulation results from the designed scenario enable developers to identify the potential for augmenting the number of active mobile game users through the implemented policies.

Based on the scenario model simulation result, the growth rate of potential use plays a big part in getting more users to play mobile games. This growth rate is an exogenous variable that significantly influences the rise in smartphone users but is beyond the control of mobile game developers. This situation implies that developers should not excessively expect a surge in new mobile device users but rather prioritize endeavors to enhance systems that depend on their efforts. Mehra *et al.* [42] said that a mobile app should have something that makes it different from other apps that do the same thing. Mobile game developers also need to be able to create unique games with features that make them more appealing.

Moreover, users can download and remove the freemium mobile games whenever they decide that the game is not interesting enough or that a competing app offers a better experience [38, 40, 41, 43] stated that acquiring new users is more expensive than keeping the existing ones. For this reason, developers should keep trying to keep any current users.

From the beginning, developers are required to deliver the best gaming experience for users via their applications. A well-designed mobile game application will enable developers to retain their users [40, 41]. Satisfied users will provide positive feedback, substantially influencing the mobile game's rating outcomes. The ratings of an application indicate its quality and will affect user adoption [71, 72].

Nam and Kim [22] emphasized that the period leading up to the product launch was critical for developers. Hence, developers should seize this opportunity to intensify the efforts to promote their mobile game applications through extensive advertising campaigns. This advertising effort aims to boost public awareness and stimulate word-of-mouth engagement among users.

In advertising, developers have an alternate method to enhance product awareness, specifically through influencer services. Leveraging influencers for advertising might occasionally demand significant expenses. Nonetheless, small developers with limited funding still have the chance to take advantage of it. In the end, these influencers require material as well. Developers may provide their games to influencers for review and promotion on their social media platforms before the official release. Another approach is to partner with certain

game publishers, who will concentrate on executing advertising campaigns after that. Regardless of the selected strategy, the focus eventually goes back to the quality of the developed game application. If a game is exceptional, several influencers will probably try to play and disseminate it via social media.

In addition, developers should cultivate intense engagement with their users via social media platforms. Through this relationship, users might be motivated to promote the mobile game product by word of mouth and by giving positive evaluations on the application distribution platforms. Maintaining relationships with users might provide developers with a strategic advantage when launching new products in the future. Developers no longer need to cultivate a user base from the ground up.

VII. Conclusion and Further Work

We introduced a dynamic model using System Dynamics to analyze user acquisition of mobile gaming systems and potential system improvements based on optimistic and pessimistic projections. The established model enables a thorough description and study of the acquisition of mobile gaming users. The model demonstrates that the user acquisition system is interconnected and has a causal relationship with factors like the presence of potential users, intention to play, enjoyment experienced while playing, and the revenue developers earn through app monetization. The scenario was created by combining a structure and a parameter scenario, both considering optimistic and pessimistic assumptions.

The combination of an optimistic structure and parameter scenario generates the best outcome, with 208.42 million active users in 2034. This scenario is 49.21% more active users than the base model. The scenario incorporates five more variables into the system to enhance the user's intention to play. The five variables include advertising campaigns, product awareness, WOM, customer relations, and product ratings. Developers should consider these variables while aiming to improve user acquisition. The scenario also makes assumptions regarding the growth rate of mobile device users who might potentially utilize mobile game applications. Within the optimistic parameter scenario, the potential user growth rate is projected to 17.78 million people annually.

This study utilizes data concerning mobile gaming acquisition in Indonesia. Similarly, scenario planning also considers Indonesia's societal peculiarities. The strategy suggested in this study may be exclusive to Indonesia, a developing Asian country. Nevertheless, there are still possibilities for further advancement in this study. Further development of this simulation model might reveal chances to enhance developers' revenue. There were 64.1 million mobile gaming users in Indonesia in 2022, generating a total revenue of US$ 980.9 million. The revenue value is unsatisfactory compared to other Asian countries, like China or South Korea, which generate higher revenue than Indonesia in this sector. Developers have encountered the challenge of converting users from unpaid users to paid users in freemium mobile games. This difficulty stems from users accustomed to downloading and playing the game at no cost being reluctant to make purchases within the application that eventually generate revenue for the developer, particularly if the user fails to recognize the additional benefits that might be gained by making an expenditure.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

H.D. (Hendra Dinata), E.S. (Erma Suryani), and J.D.T.P. (Jerry Dwi Trijoyo Purnomo) carried out conceptualization, literature review and methodology. H.D. performed the simulation process, analysis and results. E.S. and J.D.T.P. conducted the supervision of overall results; all authors had approved the final version. All authors had approved the final version.

References

[1] H. S. Jung, K. H. Kim, and C. H. Lee, "Influences of perceived product innovation upon usage behavior for MMORPG: Product capability, technology capability, and user centered design," *Journal of Business Research*, vol. 67, no. 10, pp. 2171–2178, 2014, doi: 10.1016/j.jbusres.2014.04.027.

[2] Newzoo. Global Games Market Report January 2023. [Online]. Available: https://newzoo.com/resources/trend-reports/pc-console-gaming-report-2023

[3] N. D. Bowman, S. Jöckel, and L. Dogruel, "'The app market has been candy crushed': Observed and rationalized processes for selecting smartphone games," *Entertainment Computing*, vol. 8, pp. 1–9, 2015. doi: 10.1016/j.entcom.2015.04.001

[4] H.-M. Kim, "Mobile media technology and popular mobile games," *International Journal of Mobile Marketing*, vol. 8, no. 2, pp. 42–54, 2013.

[5] A. Syvertsen, A. B. Ortiz de Gortari, D. L. King, and S. Pallesen, "Problem mobile gaming: The role of mobile gaming habits, context, and platform," *Nordic Studies on Alcohol and Drugs*, vol. 39, no. 4, pp. 362–378, 2022. doi: 10.1177/14550725221083189

[6] J. Clement. Average weekly hours spent playing video games in selected countries worldwide as of January 2021. [Online]. Available: https://www.statista.com/statistics/273829/average-game-hours-per-day-of-video-gamers-in-selected-countries/

[7] J. Clement. COVID-19 impact on the gaming industry worldwide - statistics & facts. [Online]. Available: https://www.statista.com/topics/8016/covid-19-impact-on-the-gaming-industry-worldwide/

[8] M. Barr and A. Copeland-Stewart, "Playing video games during the COVID-19 pandemic and effects on players' well-being," *Games and Culture*, vol. 17, no. 1, pp. 122–139, 2022. doi: 10.1177/15554120211017036

[9] H. Dinata, E. Suryani, and J. D. Trijoyo Purnomo, "Gaming activities during the COVID-19 pandemic era: A systematic literature review," in *Proc. 2022 International Seminar on Application for Technology of Information and Communication (iSemantic)*, 2022, pp. 161–166. doi: 10.1109/iSemantic55962.2022.9920407

[10] W. Witkowski. Videogames are a bigger industry than movies and North American sports combined, thanks to the pandemic. [Online]. Available: https://www.marketwatch.com/story/videogames-are-a-bigger-industry-than-sports-and-movies-combined-thanks-to-the-pandemic-11608654990

[11] D. Salon *et al.*, "The potential stickiness of pandemic-induced behavior changes in the United States," in *Proc. the National Academy of Sciences*, 2021, vol. 118, no. 27. doi: 10.1073/pnas.2106499118

[12] P. Steggals. The psychology of consumer behavior: Habits that are set to stick post-pandemic. [Online]. Available:

https://www.thinkwithgoogle.com/intl/en-apac/consumer-insights/consumer-trends/consumer-behavior-psychology-post-pandemic/

[13] J. Clement. Mobile gaming app revenue worldwide from 2019 to 2022. [Online]. Available: https://www.statista.com/statistics/511639/global-mobile-game-app-revenue/

[14] D. Serxner. Post Pandemic Mobile Gaming Trends. [Online]. Available: https://youappi.com/post-pandemic-mobile-gaming-trends/

[15] Statista.com. Digital Market Outlook: Mobile Game. [Online]. Available: https://www.statista.com/outlook/dmo/digital-media/video-games/mobile-games/indonesia

[16] Statista.com. Number of smartphone users in Indonesia from 2017 to 2020 with forecasts until 2026. [Online]. Available: https://www.statista.com/statistics/266729/smartphone-users-in-indonesia/

[17] U. Kaltum, R. Rimadina, and W. Zusnita, "The technology acceptance model for playing mobile games in Indonesia," in *Proc. the 2018 International Conference of Organizational Innovation, KnE Social Sciences*, 2018, pp. 1022–1034. doi: 10.18502/kss.v3i10.3445

[18] W. Rafdinal, A. Qisthi, and S. Asrilsyak, "Mobile game adoption model: Integrating technology acceptance model and game features," *Sriwijaya International Journal of Dynamic Economics and Business*, vol. 4, no. 1, 2020. doi: 10.29259/sijdeb.v4i1.43-56

[19] K. A. Kumar, S. Natarajan, and B. Acharjya, "Understanding behavioural intention for adoption of mobile games," *ASBM Journal of Management*, 2017.

[20] J. A. Laksmana and M. S. Purwanegara, "Factors influencing users' intention to play in innovative mobile gaming usage case study of valve in Indonesia," *Journal of Business and Management*, vol. 5, no. 6, pp. 764–773, 2016.

[21] S. Gao, Z. Zang, and J. Krogstie, "The adoption of mobile games in China: An empirical study," in *Proc. IFIP Advances in Information and Communication Technology*, Springer, 2014.

[22] K. Nam and H. J. Kim, "The determinants of mobile game success in South Korea," *Telecommunications Policy*, vol. 44, no. 2, 101855, 2020. doi: 10.1016/J.TELPOL.2019.101855

[23] J. M. Lyneis, "System dynamics for market forecasting and structural analysis," *System Dynamics Review*, vol. 16, pp. 3–25, 2000.

[24] J. W. Forrester, *Industrial Dynamics*, Cambridge, MA: MIT Press, 1961.

[25] M. Bastan, R. R. Khorshid-Doust, S. D. Sisi, and S. Akbarpour, "Revenue structure of mobile banking: A system dynamics model," in *Proc. the 2017 International Symposium on Industrial Engineering and Operations Management (IEOM)*, Bristol, UK, July 24, 2017.

[26] M. Becerra, M. M. Herrera, and E. M. Correa, "Financial Profitibility Model Using System Dynamics," in *Proc. XII Encuentro Colombiano de Dinámica de Sistemas*, Bogotá D.C., Colombia, 2014.

[27] S. Y. Roodsari, "Using system dynamics for simulation and optimization of an investment decision system under uncertainty," *Process Integration and Optimization for Sustainability*, vol. 6, no. 2, pp. 367–381, 2022. doi: 10.1007/s41660-021-00219-x

[28] Q. Yan, S. Zhou, X. Zhang, and Y. Li, "A system dynamics model of online stores' sales: Positive and negative E-WOM and promotion perspective," *Sustainability*, vol. 11, no. 21, 6045, 2019. doi: 10.3390/su11216045

[29] T.-S. Lan, Y.-H. Lan, K.-L. Chen, P.-C. Chen, and W.-C. Lin, "A study of developing a system dynamics model for the learning effectiveness evaluation," *Mathematical Problems in Engineering*, vol. 2013, pp. 1–6, 2013. doi: 10.1155/2013/298621

[30] E. Abbasi, M. Bastan, and A. M. Ahmadvand, "A system dynamics model for mobile banking adoption," in *Proc. 12th International Conference on Industrial Engineering (ICIE 2016)*, Tehran, Iran, 2016.

[31] E. Suryani, S.-Y. Chou, and C.-H. Chen, "Dynamic simulation model of air cargo demand forecast and terminal capacity planning," *Simulation Modelling Practice and Theory*, vol. 28, pp. 27–41, 2012. doi: 10.1016/j.simpat.2012.05.012

[32] S. Li, S. Ma, and J. Zhang, "Building a system dynamics model to analyze scenarios of COVID-19 policymaking in tourism-dependent developing countries: A case study of Cambodia," *Tourism Economics*, 2022. doi: 10.1177/13548166211059080

[33] L. Shen, L. Du, X. Yang, X. Du, J. Wang, and J. Hao, "Sustainable strategies for transportation development in emerging cities in China: A simulation approach," *Sustainability*, vol. 10, no. 3, 844, 2018. doi: 10.3390/su10030844

[34] Y. Liu and H. Li, "Exploring the impact of use context on mobile hedonic services adoption: An empirical study on mobile gaming in China," *Computers in Human Behavior*, vol. 27, no. 2, pp. 890–898, 2011. doi: 10.1016/J.CHB.2010.11.014

[35] I. A. Zolkepli, S. N. S. Mukhiar, and C. Tan, "Mobile consumer behaviour on apps usage: The effects of perceived values, rating, and cost," *Journal of Marketing Communications*, pp. 1–23, 2020. doi: 10.1080/13527266.2020.1749108

[36] A. V. M. Moreira, V. V. Filho, and G. L. Ramalho, "Understanding mobile game success: a study of features related to acquisition, retention and monetization," *SBC Journal on Interactive Systems*, vol. 5, no. 2, pp. 2–13, 2014.

[37] T. Zhou, "Understanding the effect of flow on user adoption of mobile games," *Personal and Ubiquitous Computing*, vol. 17, no. 4, 2013. doi: 10.1007/s00779-012-0613-3

[38] J. Liu and J. Lee, "Factors Analysis Influencing the Switching Intention of Chinese Mobile Games based on Push-Pull-Mooring Model," *Journal of Information Technology Applications and Management*, vol. 27, no. 5, pp. 49–68, 2020.

[39] L. Zheng, "The role of consumption emotions in users' mobile gaming application continuance intention," *Information Technology & People*, vol. 33, no. 1, 2019. doi: 10.1108/ITP-04-2018-0197

[40] A. Drachen *et al.*, "Rapid prediction of player retention in free-to-play mobile games," in *Proc. the AAAI AIIDE*, July 11, 2016.

[41] J. Yi, Y. Lee, and S. H. Kim, "Determinants of growth and decline in mobile game diffusion," *Journal of Business Research*, vol. 99, pp. 363–372, 2019. doi: 10.1016/J.JBUSRES.2017.09.045

[42] A. Mehra, J. Paul, and R. P. S. Kaurav, "Determinants of mobile apps adoption among young adults: theoretical extension and analysis," *Journal of Marketing Communications*, vol. 27, no. 5, pp. 481–509, 2021. doi: 10.1080/13527266.2020.1725780

[43] P. Tiwari, R. P. S. Kaurav, and K. Y. Koay, "Understanding travel apps usage intention: Findings from PLS and NCA," *Journal of Marketing Analytics*, vol. 12, no. 1, pp. 25–41, 2024. doi: 10.1057/s41270-023-00258-y

[44] T. T. Cota, L. Ishitani, and N. Vieira, "Mobile game design for the elderly: A study with focus on the motivation to play," *Computers in Human Behavior*, vol. 51, pp. 96–105, 2015. doi: 10.1016/J.CHB.2015.04.026

[45] B. de Schutter and V. V. Abeele, "Designing meaningful play within the psycho-social context of older adults," in *Proc. the 3rd International Conference on Fun and Games - Fun and Games '10*, 2010, pp. 84–93. doi: 10.1145/1823818.1823827

[46] I. Mulyawan and W. Rafdinal, "Mobile games adoption: An extension of technology acceptance model and theory of reasoned action," in *IOP Conference Series: Materials Science and Engineering*, 2021, vol. 1098, 032022, 2021. doi: 10.1088/1757-899X/1098/3/032022.

[47] X. Cai, J. Cebollada, and M. Cortiñas, "From traditional gaming to mobile gaming: Video game players' switching behaviour," *Entertainment Computing*, 100445, 2022. doi: 10.1016/J.ENTCOM.2021.100445.

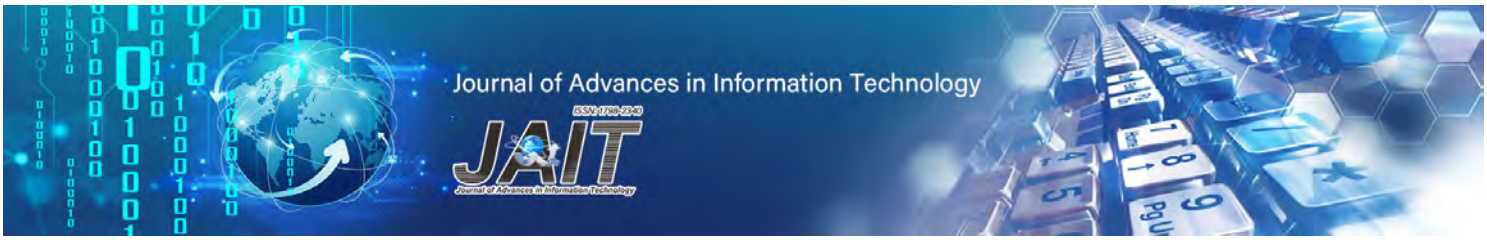
[48] C. Chen, "Playing mobile games for stress recovery purposes: A survey of Chinese adolescents," *Telematics and Informatics*, vol. 56, 2021. doi: 10.1016/J.TELE.2020.101481

[49] J. Li, D. Zhan, Y. Zhou, and X. Gao, "Loneliness and problematic mobile phone use among adolescents during the COVID-19 pandemic: The roles of escape motivation and self-control," *Addictive Behaviors*, vol. 118, 2021. doi: 10.1016/j.addbeh.2021.106857

[50] P.-S. Wei and H.-P. Lu, "Why do people play mobile social games? An examination of network externalities and of uses and gratifications," *Internet Research*, vol. 24, no. 3, 2014. doi: 10.1108/IntR-04-2013-0082

[51] J. T. Alexander, J. Sear, and A. Oikonomou, "An investigation of the effects of game difficulty on player enjoyment," *Entertainment Computing*, vol. 4, no. 1, pp. 53–62, 2013. doi: 10.1016/J.ENTCOM.2012.09.001

[52] J. D. Sterman, *Business Dynamics: System Thinking and Modeling for a Complex World*, New York City, 2000.
[53] A. Zhu, D. Wang, Y. Chen, and Z. Guo, "Optimization of the Beijing economy-energy-emissions system 2021–2035: A scenario simulation analysis based on a system dynamics model," *Science Progress*, vol. 105, no. 3, 2022. doi: 10.1177/00368504221118231
[54] E. Wolstenholme. The potential of system dynamics. leading edge. [Online]. Available: https://studylib.net/doc/8646686/the-potential-of-system-dynamics
[55] Y. Barlas, "Multiple tests for validation of system dynamics type of simulation models," *European Journal of Operational Research*, vol. 42, no. 1, pp. 59–87, 1989. doi: 10.1016/0377-2217(89)90059-3.
[56] K. L. Hsiao and C. C. Chen, "What drives in-app purchase intention for mobile games? An examination of perceived values and loyalty," *Electronic Commerce Research and Applications*, vol. 16, 2016. doi: 10.1016/J.ELERAP.2016.01.001
[57] E. J. Jeong and D. J. Kim, "Definitions, key characteristics, and generations of mobile games," in *Mobile Computing*, IGI Global, 2009.
[58] Canalys. Google's Android becomes the world's leading smart phone platform. [Online]. Available: https://www.canalys.com/newsroom/google's-android-becomes-world's-leading-smart-phone-platform
[59] J. Amankwah-Amoah, Z. Khan, G. Wood, and G. Knight, "COVID-19 and digitalization: The great acceleration," *Journal of Business Research*, vol. 136, pp. 602–611, 2021, doi: 10.1016/j.jbusres.2021.08.011
[60] S. Aleem, L. F. Capretz, and F. Ahmed, "Empirical investigation of key business factors for digital game performance," *Entertainment Computing*, vol. 13, pp. 25–36, 2016. doi: 10.1016/j.entcom.2015.09.001
[61] S. Gong, W. Wang, and Q. Li, "Marketing communication in the digital age: online ads, online WOM and mobile game adoptions," *Nankai Business Review International*, vol. 10, no. 3, 2019. doi: 10.1108/NBRI-12-2018-0073
[62] R. Sama, "Impact of media advertisements on consumer behaviour," *Journal of Creative Communications*, vol. 14, no. 1, pp. 54–68, 2019. doi: 10.1177/0973258618822624
[63] A. Aryun, D. D. Nugraha, L. D. Karachi, M. Ruswan, and N. Abdurrahman, "The effect of advertising exposure on brand awareness and the desire to play AoV game," *COMMENTATE: Journal of Communication Management*, vol. 1, no. 1, 2020. doi: 10.37535/103001120208 (in Indonesian)
[64] J. Kreissl, D. Possler, and C. Klimmt, "Engagement with the gurus of gaming culture: Parasocial relationships to let's players," *Games and Culture*, vol. 16, no. 8, pp. 1021–1043, 2021. doi: 10.1177/15554120211005241
[65] M. L. Hakim and T. A. Indarwati, "The influence of influencer marketing and emotional value on purchase intention of virtual skin products in the mobile legends game: Bang Bang," *Jurnal Ilmu Manajemen*, vol. 10, no. 1, pp. 199–209, 2022. (in Indonesian)
[66] D. Godes and D. Mayzlin, "Firm-created word-of-mouth communication: Evidence from a field test," *Marketing Science*, vol. 28, no. 4, pp. 721–739, 2009. doi: 10.1287/mksc.1080.0444
[67] H.-M. Lee, P. Zhang, and M. R. Mehta, "Effect of competitors' eWOM in the mobile game market," *Journal of Computer Information Systems*, vol. 62, no. 1, pp. 196–204, 2022. doi: 10.1080/08874417.2020.1768176
[68] X. Li and L. Wu, "Observational learning and social-network word-of-mouth: Evidence from groupon," *Mis Quarterly*, 2013. doi: 10.2139/ssrn.2264411
[69] D. Vidyanata, "Understanding the effect of social media marketing on purchase intention: A value-based adoption model," *Jurnal Dinamika Manajemen*, vol. 13, no. 2, pp. 305–321, 2022.
[70] J. Getomer, M. Okimoto, and B. Johnsmeyer. Gamers on Youtube evolving video consumption. [Online]. Available: http://ssl.gstatic.com/think/docs/youtube-marketing-to-gamers_articles.pdf
[71] O. Rutz, A. Aravindakshan, and O. Rubel, "Measuring and forecasting mobile game app engagement," *International Journal of Research in Marketing*, vol. 36, no. 2, pp. 185–199, 2019. doi: 10.1016/J.IJRESMAR.2019.01.002
[72] M. Sun, "How does the variance of product ratings matter?" *Management Science*, vol. 58, no. 4, pp. 696–707, 2012. doi: 10.1287/mnsc.1110.1458
[73] I. D. Corporation. Indonesia's smartphone market ended 2022 down 14.3%, IDC reports. [Online]. Available: https://www.idc.com/getdoc.jsp?containerId=prAP50404323
[74] G. P. Jones, C. Stambaugh, N. Stambaugh, and K. E. Huber, "Analysis of variance," in *Translational Radiation Oncology*: Elsevier, 2023, pp. 171–177.
[75] T. K. Kim, "Understanding one-way ANOVA using conceptual figures," *Korean Journal of Anesthesiology*, vol. 70, no. 1, 22, 2017. doi: 10.4097/kjae.2017.70.1.22



Journal Menu

General Information

ISSN: 1798-2340 (Online)

Frequency: Monthly

DOI: 10.12720/jait

Indexing: ESCI (Web of Science) (https://mjl.clarivate.com/home), Scopus (https://www.scopus.com/sourceid/21101017116), CNKI (https://scholar.cnki.net/journal/index/SJDJ179823400926), *etc*.

Acceptance Rate: 12%

APC: 1000 USD

Average Days to Accept: 87 days

Journal Metrics:

Impact Factor 2023: 0.9

4.2
(https://www.scopus.com/sourceid/21101017116?
dgcid=sc_widget_citescore)

2023
CiteScore

opus.com/sourceid/21101017116?
dgcid=sc_widget_citescore)

57th percentile

(https://www.scopus.com/sourceid/21101017116?

dgcid=sc_widget_citescore)

Powered by Scopus

(https://www.scopus.com/sourceid/21101017116?

dgcid=sc_widget_citescore)

(https://www.scimagojr.com/journalsearch.php?

q=21101017116&tip=sid&exact=no)

Editor-In-Chief

Prof. Kin C. Yow
University of Regina, Saskatchewan, Canada

I'm delighted to serve as the Editor-in-Chief of *Journal of Advances in Information Technology*. *JAIT* is intended to reflect new directions of research and report latest advances in information technology. I will do my best to increase the prestige of the journal.

What's New

2025-01-23
JAIT Vol. 16, No. 1 has been published online! (https://www.jait.us/list-249-1.html)

2025-01-10

All 12 papers published in JAIT Vol. 15, No. 10 have been indexed by Scopus. (https://www.scopus.com/sourceid/21101017116?dgcid=sc_widget_citescore)

2024-06-07

JAIT received the CiteScore 2023 with 4.2, ranked #169/394 in Category Computer Science: Information Systems, #174/395 in Category Computer Science: Computer Networks and Communications, #226/350 in Category Computer Science: Computer Science Applications (https://www.jait.us/index.php?m=content&c=index&a=show&catid=23&id=1542)

Volume 16, No. 1, 2025

CONTENT (http://www.jait.us/articles content.pdf)

Published by ETP (http://www.etpub.com)