The Impact of Social Media Engagement on Market Share: A System Dynamics Model

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Abstract

Background: Some studies have shown that Return on Total Assets is a strategy to increase market share. Other studies have also shown that social media like WeChat can increase market share. However, no studies have considered Instagram engagement in increasing market share.
Objective: This study aims to identify variable linkage that increases market share through a dynamic system approach in small and medium-sized enterprises (SMEs).
Methods: Using a System Dynamics approach, this study presents a model simulation with a proposed increase in market share by considering Instagram features. This approach creates a Causal Loop Diagram converted into a simulated Stock Flow Diagram. The value generated from the simulation is validated with the mean comparison and % error variance formulas.
Results: Instagram engagement increases market share from 0.009 to 0.018. Such engagement can be increased by posting regularly and doing more activities, such as increasing post frequency, holding contests, and maximizing all features.
Conclusion: This study has successfully modeled information technology, i.e., a promotion module on social media. However, this work has not yet demonstrated how the features can gain more market share, so future research is needed.

Keywords: Causal Loop Diagram, Engagement, Market Share, Stock Flow Diagram, System Dynamics

I. INTRODUCTION

Small and medium-sized enterprises (SMEs) development is accompanied by digital transformation, such as sales through e-commerce platforms, marketplaces, social media, and other digital channels [1], [2]. SMEs with advanced e-commerce channels benefit from digital platforms [2]. A company's success, including SMEs, in an industrial sector can be assessed by its market share [3] or the percentage of total sales in the industry [4]. In the financial sector, the impact of market share is studied widely to formulate a sales strategy [5]. Market research informs a company about market developments, trends, customers, or competitors in the same business field [6].

Previous research has succeeded in measuring the market share ratio [7], and it can be increased through WeChat [8]. Although Instagram has become a vital platform for customer outreach [9] [10], with more than 12 billion global users [11], past research has not evaluated its impact. This study aims to investigate Instagram features' role in increasing market share and develop a model to simulate the relationship between the variables.

This study uses a dynamic system approach to model the variable. The development begins with determining relevant variables that influence market share expansion. These variables are then compiled into a Causal Loop Diagram (CLD). The CLD displays an initial overview of the modeled process flow, which becomes the basis for creating System Flow Diagrams (SFD). The SFD contains formulation variables that can be simulated. The value generated from the simulation is validated with the mean comparison formula and % error variance. The valid model becomes the basis for creating scenarios to increase the SME market share.

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II. METHODS

One of the benefits of system modeling is that it does not change the system itself. One way to do this is by using the dynamic system method, which emulates the real system and converts it into a computer-simulated model [12]. This study uses a research methodology based on [13], which consists of five steps and has been widely used as the basis for methodology development in system dynamics. These steps are as follows:

A. Problem Statement

The problem is defined in this stage, as well as the variables that are most relevant to the system. Other supporting variables are developed based on literature studies, interviews, data analysis, and observation of real systems. Market share and customer satisfaction often assess marketing performance [14]. Market share is calculated from sales in a certain period divided by industry sales in the same period [4], as shown in Equation (1). The number 100 in Equation (1) gives a result with a percentage.

$$\text{Market Share} = \frac{Company\ Income}{Total\ Industry\ Revenue}\ x\ 100 \tag{1}$$

Market share is often used to describe the position and success of a company [3]. The impact of market share is not always reflected in the profitability or performance of the company, but many companies see it as an important organizational goal [3]. In past research [15], market share is considered as part of the function of investment media and it controls brand prices. In another study, the authors found that customer satisfaction can predict a company's future market share against its closest competitors [14]. Banking companies also make market share an important element for profitability, growth, and viability [16]. Thus, in this case, the shoe laundry SME is appropriate to consider market share strategic planning.

The impact of market share on financial firm performance is one of the most studied relationships in marketing strategy research [5]. Research has also shown that consumer engagement can have a positive or negative influence on the company [17] because consumers are not just buyers but also a marketer for the company [18]. Therefore, many companies have launched engagement initiatives to develop brand-customer solid relationships [19].

All types of contextual factors can be modeled through a system dynamics model. System dynamics is a language for simulating complex systems based on a generic understanding of the system. System dynamics provides a vocabulary for describing and analyzing systems and is suitable for describing various variables [20]. The system dynamics model is a complex system whose behaviors change over time. There are two approaches to building a system dynamics model: top-down and bottom-up. The system built in this study uses a top-down approach [21]. The system dynamic modeling is visual-based and takes a holistic perspective of all the relevant elements and risks [22]. Several tools can build the model, such as Stock, Flow, Converter, and Connector [21].

The model is built by knowing the relationship between variables to time, described in the Stock and Flow diagram, and the mathematical conditions. The development is based on the work by [23], namely: 1) problem identification, 2) concept model construction, 3) formal model development, 4) model analysis and validation, and 5) policy analysis and design. Previous research using system dynamics modeling shows that service quality affects customer satisfaction and customer loyalty [24].

The current study takes shoe laundry SME as a case study. The SME attempts to market their products through Instagram, targeting young people aged 18-35 years in Surabaya City area and Sidoarjo Regency. There are internal and external factors influencing market share, as shown in Table 1. These include market size and the company's sales volume and competitors [26], [27]. Inconsistent posting and lack of engagement can also show that the marketing reach is small [28].

B. Dynamic Hypothesis

In Causal Loop Diagram, all variables found are assembled and their causal relationships analyzed. Each variable is also categorized into existing sub-systems. In the market share sub-model, the significant variables are competitors, average sales competitors, customers, potential customers, new customers, and engagement from social media to prospective customers. Past research [26] has shown that market share is the percentage of regular customers to the total existing market. Customers may come (new customers) and leave (churn customers). New customer will engage on social media if they are encouraged. Potential customers will also be generated if the market grows by the way the company converts customers from competitors, as shown in Fig. 1.

TABLE 1
STRUCTURE VALIDATION AND THE SOURCES

Sub Model	Internal Factors	External Factors
Market share	Market Size [26]	Churn Rate [26]
	Churn Customer [26]	Competitor avg. sale [27]
	Total Customer [26]	Competitor [27]
	Market Share [26]	
Operasional and Sales	New Customer [26]	Water Cost [29]
	Order [29]	Water Usage [29]
	Operational Cost [29]	Number of employee [29]
	Profit [29]	Electricity Cost [29]
	Service Cost [29]	Employee Salary Expenses [29]
	Service Price [29]	Labour cost [29]
	Investment [27]	Electricity Usage [29]
Instagram Engagement	Impression [28]	Likes [30]
	Engagement [28]	Followers [31]
	Comments [30]	Number of post [30]
	Save [30]	

In the order sub-model, there are operational costs, profits, and orders variables. In terms of orders, total customers affect the number of existing orders, which affects the income earned, influenced by the SME's service prices. The profit is taken from the total service price with the target to achieve a minimum break-even point. On the fixed cost/operational cost side the variables are electricity costs, electricity usage, water costs, and water usage. Meanwhile, the fixed costs are employee salaries .
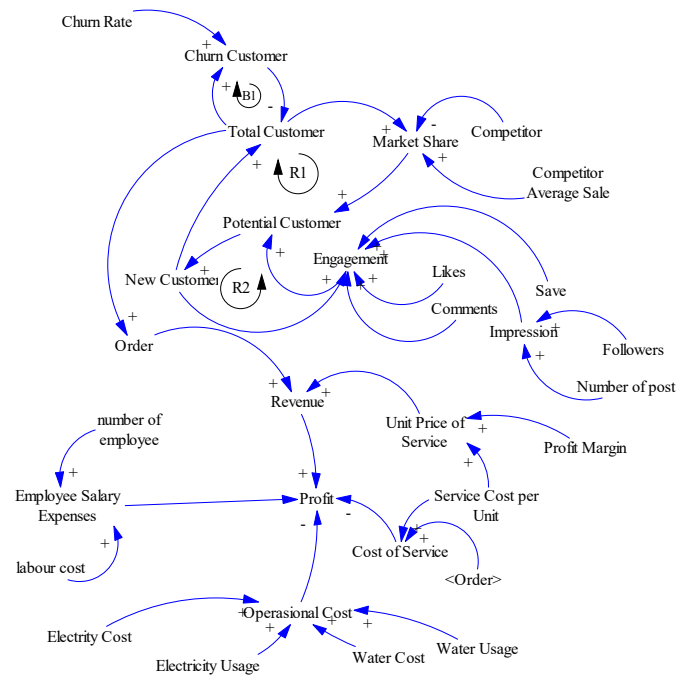

Fig. 1 CLD of the existing condition

According to [30] and [31], engagement includes comments, likes, saves, total posts, and the number of followers. The existence of comments, likes, and saves greatly affects engagement because to appear in the explore section on Instagram, the engagement must reach a certain benchmark, which is determined by the Instagram algorithm. A post to appear on the Instagram explore page can reach more people, hence, the conversion rate [13].

C. *Formulation Simulation Model*

CLD model is converted into a computer simulation model based on existing conditions [25]. The simulation model is a stock-flow diagram. Each existing variable and its formulation are inputted into the stock-flow diagram to be simulated to obtain a real model according to the real system conditions [12]. The results of this model are presented in the discussion section.

D. *Testing and Validation*

The data for model validation consists of the shoe laundry's customers, sales, market share. The validation process is important so the model fits the real conditions and includes both formal and informal aspects [23]. According to [32], system validation consists of the average value or mean comparison, which can be seen in Equation (2), and the value of amplitude variation or error variance, which can be seen in Equation (3). For average comparison, the model is considered valid if the results of E1 are below 5%, and the value of E2 does not exceed 30% [32]. If both are met, then the model is valid. The formula is as follows:

$$E1 = \frac{[\bar{S} - \bar{A}]}{\bar{A}} \qquad (2)$$

where $\bar{S}$ is the average value of the simulation results and $\bar{A}$ is the average value of the data, E2 with S_s = standard deviation of the simulation model and S_a = standard deviation of real data with the following formula:

$$E2 = \frac{[S_s - S_a]}{S_a} \qquad (3)$$

E. *Scenarios*

The scenario stage changes the system into a new one, hypothesized to produce the desired outcomes [25], namely increasing market share. This step is not limited to changing the parameter values but also changing the structure of the model [13]. The scenario concerns primarily on engagement [28] on Instagram social media [28], [30].
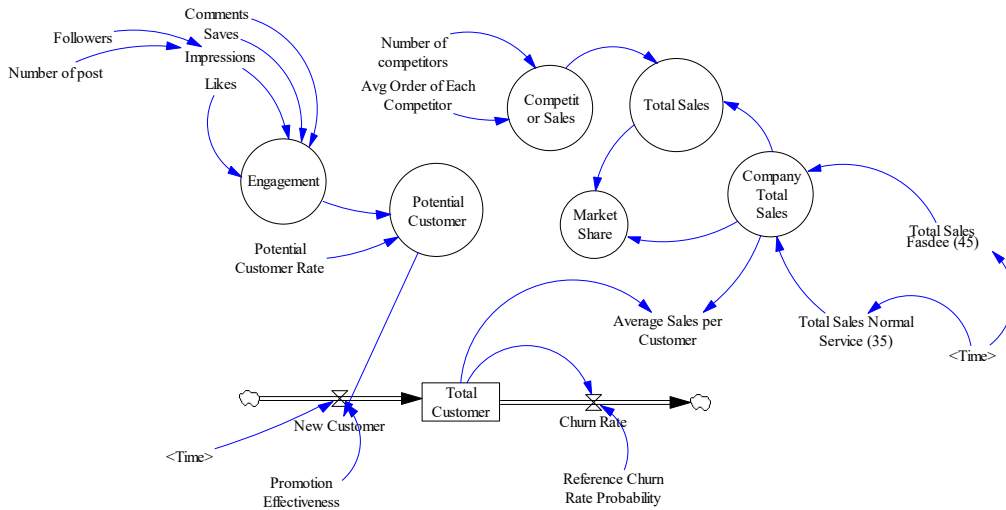

Fig. 2 SFD of customer, order, engagement, and market share

III. RESULT

The discussion part of this research is divided into three parts, namely SFD, model validation, and scenarios. In the SFD section, the results of the conversion from CLD to SFD are explained, along with each of its sub-systems. In the model validation section, data validation was carried out between real data and simulated data, and adjustments were

made to the error rate below 5% for E1 and 30% for E2 [25], [32]. In the scenario section, changes are made to the model structure in accordance with the new strategy that focuses on engagement on social media.

A. *Stock Flow Diagram*

Stock Flow Diagram (SFD) is a flow chart that can be simulated on a computer to implement a quantitative CLD, written in a certain language format [12]. The SFD development in this study is divided into four parts: customer SFD, operational SFD, order and market share SFD, and profit SFD. Customer SFD simulates the number of customers. What affects the total customer is the number of new customers, the number of churn customers [26], and the number of potential new customers. Order and market share SFD display the existing conditions of the SME's social media with stagnant low engagement. The detail is shown in Fig. 2.

Operational SFD describes the simulation of the amount of expenditure made by the company, each expenditure variable that has the greatest influence is integrated into one variable. The total operational costs are often made by companies based on direct interviews with SME owners and based on the concept of expense accounting [29], as shown in Fig. 3.
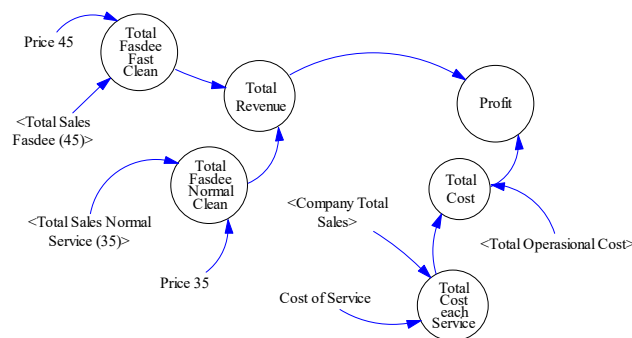

Fig. 3 SFD of Operational and Profit

B. *Model Validation*

In this step, to ensure that the framework follows the real conditions, structural validation is carried out on the CLD model built in the dynamic hypothesis section. In this section, all variables are grouped into endogenous and exogenous variables according to their position and sub-systems. Furthermore, each variable is compared with the literature to map the variables and their literature sources and compare the validity. This follows the steps set in [13] to ensure that the resulting CLD represents the real system.

The part that needs to be validated in the simulation is the customers. The simulation data used real data from the first to the twelfth month, from July 2020 to June 2021. The results of customer data validation are shown in TABLE 2. The results of the validation of income and expenses of the stock-flow diagram model are shown in TABLE 2. The result of the simulation model is valid because the variables deviation (E2) and averaging (E1) are below 30% and 5% respectively.

C. *Scenario Development*

The structural scenario was developed by adding engagement variables. The variables related to engagement are the number of comments, number of likes, number of posts, followers level, Instagram reach, Instagram reach, contest, relevant hashtags, and feature usage, as shown in Fig. . To increase the value of the main variable, the strategies are holding a quiz event, using hashtags that are relevant to the product, and maximizing Instagram features. The scenario period is the 14th to 60th period (month time unit) as shown in Equation (4). Promotion effectiveness is part of customer growth, showing how Instagram affects the number of potential customers converted to customers as shown in Fig. 4.

$$Number\ of\ Customer\ =\ (Potential\ Customer * Promotion\ Effectiveness) + \quad (4)$$
$$RANDOM\ NORMAL(5, 17, 15.2308, 4.55552, 0))$$

The formulation is to display the results of the engagement scenario. The formulation is placed on the 'new customer' variable. From the 'time' variable above, it appears that the scenario is carried out right after the 12th period.

TABLE 2
CUSTOMER. COST, EXPENSE, AND REVENUE VALIDATION

| Month	Customer Validation		Revenue Validation		Revenue Validation		Operational Cost			
	Real Data	Simulation Data	Real Revenue (Rp)	Simulation Revenue (Rp)	Real Service Cost (Rp)	Simulation Service Cost (Rp)	Real Op. Expense (Rp)	Simulation Op. Expense (Rp)	Real Expense per Service (Rp)	Simulation Expense per Service (Rp)
2020-07	20	15	205,000	205,000	98,520	98,520	1,799,617	1,799,563	98,520	98,520
2020-08	19	18	340,000	340,000	157,632	157,632	1,799,384	1,799,448	157,632	157,632
2020-09	20	20	600,000	620,000	275,856	275,856	1,799,084	1,797,920	275,856	275,856
2020-10	18	21	535,000	570,000	256,152	275,856	1,799,697	1,799,782	256,152	275,856
2020-11	21	20	685,000	675,000	334,968	334,968	1,799,693	1,799,382	334,968	334,968
2020-12	20	17	935,000	900,000	453,192	433,488	1,799,463	1,799,494	453,192	433,488
2021-01	18	19	260,000	595,000	118,224	295,560	1,798,269	1,798,238	118,224	295,560
2021-02	19	18	600,000	835,000	315,264	413,784	1,798,975	1,799,161	315,264	413,784
2021-03	20	21	1,420,000	1,420,000	709,344	709,344	1,799,916	1,797,767	709,344	709,344
2021-04	16	22	1,940,000	1,905,000	906,384	886,680	1,799,707	1,799,906	906,384	886,680
2021-05	18	20	1,310,000	915,000	630,528	453,192	998,334	1,001,398	630,528	453,192
2021-06	20	23	600,000	690,000	275,856	354,672	998,200	998,127	386,915	394,080
E1	3.03%		1.70%		1.85%		0.0004281%		1.85%	
E2	25.00%		11.51%		11.74%		0.4214061%		11.74%	
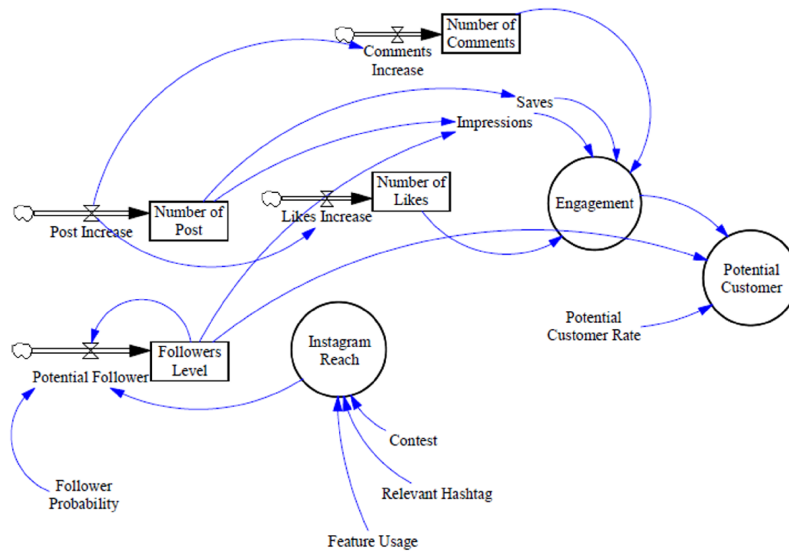
Fig. 4 Scenario Development

IV. DISCUSSION

System dynamics has successfully constructed a simulation model of brand extension's effect on the parent brand-customer equity value [33]. The results show that adopting an extension with a low perceived fit, in the long run, has no negative impact on the enterprise. It will also lead to an increase in enterprise customer equity [33]. However, the research has not involved market share variables. Similar research has successfully modeled a causal loop diagram of an SME's market share and profit gain [34]. The modeling involves variables related to social media, such as Instagram, Facebook, and WhatsApp. However, the modeling does not involve variables related to Instagram engagement. This study focuses more on the role of Instagram features.
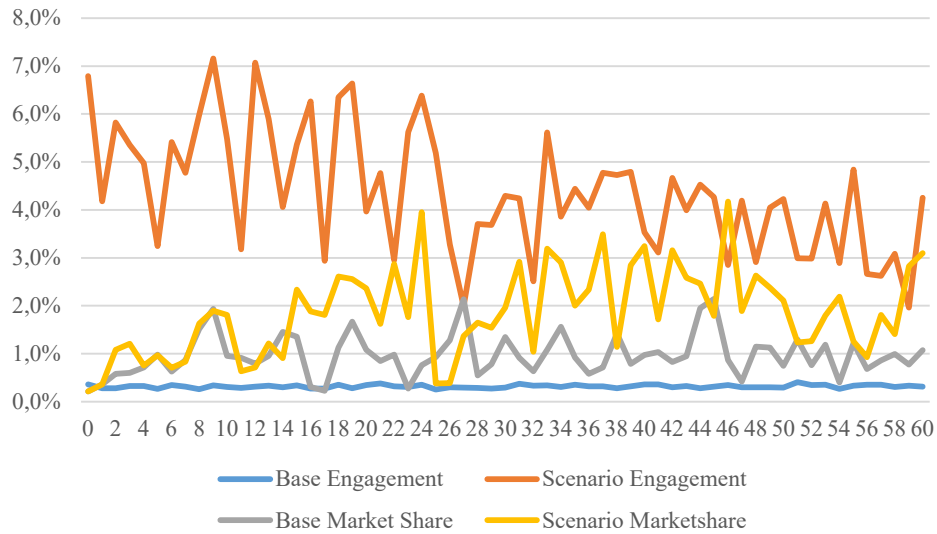
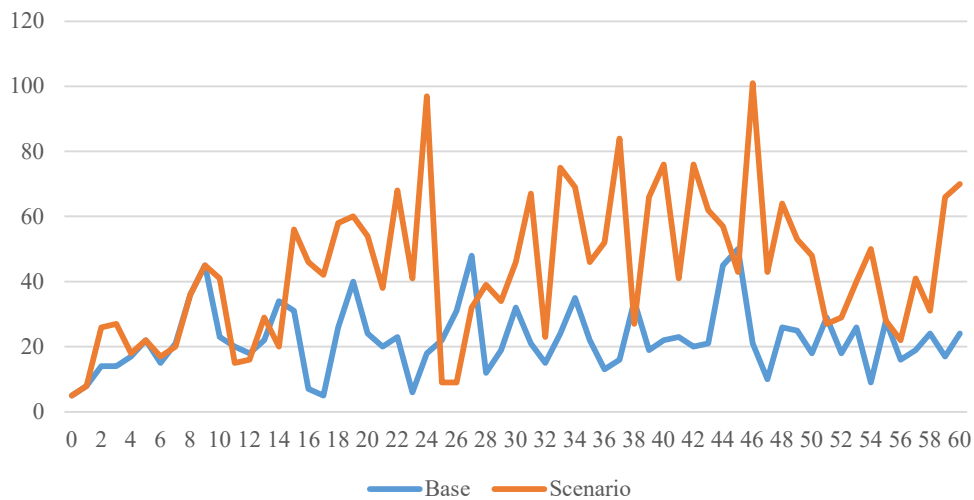Fig. 5 Interpretation of Engagement and Market Share

Fig. 6 Interpretation of Company Total Sales

The scenario in Fig. 5 shows the engagement trends, the number of new customers, the company's total sales, and the profit value. The scenario shows the trend in blue and gray for the base model results and orange and yellow for the scenario model results. The scenario results show a significant engagement increase from below 0.01 to around 0.07. In other words, the market share has also increased. It appears that in the 46th period, the market share has exceeded 0.04. The market share value increased from an average of 0.009 to 0.018. The increasing market share also shows in the company total sales from 2305 to 2317 units. This can be seen in Fig. 6. This result shows a different result from [8], which uses the social media approach to promote WeChat social media. In this research, engagement increased is with the potential customers and reoccurring customers.

V. CONCLUSIONS

This study successfully modeled the use of Instagram for the SMEs. The research question from this work is about the relationship between variables that increase market share in Instagram. A system dynamics simulation model has successfully displayed the strategy formulation to increase market share. To increase the market share, the model must also increase engagement value. The scenario model shows how engagement increased after including Instagram

features in the simulation model. The increasing trend is also found in the new customers, total company sales, and profit values. Instagram features considered in the simulation model are the number of comments, saves, impressions, likes, followers, and posts.

This result could help SMEs use Instagram to increase their market share. Engagement can be increased by increasing the number of posts, holding contests (quiz, give away, tagging friends, and so on), or maximizing the use of Instagram features (reels, stories, posts, IG TV, filters, and Instagram shop). However, this work has not yet demonstrated how these features will impact market share gains. Therefore, further work can model how each feature affects market share in terms of the weight of its influence.

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REFERENCES

[1] R. Rahayu and J. Day, "E-commerce adoption by SMEs in developing countries: evidence from Indonesia," *Eurasian Bus. Rev.*, vol. 7, no. 1, pp. 25–41, Apr. 2017, doi: 10.1007/s40821-016-0044-6.

[2] Y. Dirgiatmo, Z. Abdullah, and R. H. R. M. Ali, "Social media practices in Indonesian SMEs," *Int. J. Bus. Inf. Syst.*, vol. 35, no. 1, p. 3, 2020, doi: 10.1504/IJBIS.2020.109556.

[3] N. O'Regan, "Market share: the conduit to future success?," *Eur. Bus. Rev.*, vol. 14, no. 4, pp. 287–293, Aug. 2002, doi: 10.1108/09555340210434474.

[4] J. Romaniuk, "Modeling mental market share," *J. Bus. Res.*, vol. 66, no. 2, pp. 188–195, Feb. 2013, doi: 10.1016/j.jbusres.2012.07.012.

[5] A. Edeling and A. Himme, "When Does Market Share Matter? New Empirical Generalizations from a Meta-Analysis of the Market Share–Performance Relationship," *J. Mark.*, vol. 82, no. 3, pp. 1–24, May 2018, doi: 10.1509/jm.16.0250.

[6] T. Ambler, "Marketing Metrics," *Bus. Strateg. Rev.*, vol. 11, no. 2, pp. 59–66, Jun. 2000, doi: 10.1111/1467-8616.00138.

[7] B. Saputra, "Faktor-Faktor Keuangan Yang Mempengaruhi Market Share Perbankan Syariah Di Indonesia," *Akuntabilitas*, vol. 7, no. 2, pp. 123–131, Feb. 2016, doi: 10.15408/akt.v7i2.2675.

[8] A. B. P. Irianto, "Pemanfaatan Social Media untuk Meningkatkan Market Share UKM," *J. Teknomatika*, vol. 8, no. 1, pp. 1–12, 2015, [Online]. Available: https://www.researchgate.net/profile/Aloysius-Irianto/publication/322498793_Pemanfaatan_Social_Media_Untuk_Meningkatkan_Market_Share_Ukm/links/5a5c34ac458515450278aab3/Pemanfaatan-Social-Media-Untuk-Meningkatkan-Market-Share-Ukm.pdf.

[9] K. H. Chu, J. P. Allem, T. B. Cruz, and J. B. Unger, "Vaping on instagram: Cloud chasing, hand checks and product placement," *Tob. Control*, vol. 26, no. 5, pp. 575–578, 2017, doi: 10.1136/tobaccocontrol-2016-053052.

[10] J. P. Allem and A. Majmundar, "Are electric scooters promoted on social media with safety in mind? A case study on Bird's Instagram," *Prev. Med. Reports*, vol. 13, no. November 2018, pp. 62–63, 2019, doi: 10.1016/j.pmedr.2018.11.013.

[11] S. H. Liao, R. Widowati, and C. J. Cheng, "Investigating Taiwan Instagram users' behaviors for social media and social commerce development," *Entertain. Comput.*, vol. 40, no. 151, p. 100461, 2022, doi: 10.1016/j.entcom.2021.100461.

[12] E. Prahasta, *Systems Thinking & Pemodelan Sistem Dinamis*. Bandung: Informatika, 2019.

[13] J. D. Sterman, *Business Dynamics - Systems Thinking and Modeling for a Complex World*. McGraw-Hill, 2000.

[14] L. L. Rego, N. A. Morgan, and C. Fornell, "Reexamining the Market Share–Customer Satisfaction Relationship," *J. Mark.*, vol. 77, no. 5, pp. 1–20, Sep. 2013, doi: 10.1509/jm.09.0363.

[15] J. Morais, C. Thomas-Agnan, and M. Simioni, "Using compositional and Dirichlet models for market share regression," *J. Appl. Stat.*, vol. 45, no. 9, pp. 1670–1689, Jul. 2018, doi: 10.1080/02664763.2017.1389864.

[16] H. H. Khan, R. B. Ahmad, and S. G. Chan, "Market structure, bank conduct and bank performance: Evidence from ASEAN," *J. Policy Model.*, vol. 40, no. 5, pp. 934–958, Sep. 2018, doi: 10.1016/j.jpolmod.2018.02.001.

[17] D. K. X. Do, K. Rahman, and L. J. Robinson, "Determinants of negative customer engagement behaviours," *J. Serv. Mark.*, vol. 34, no. 2, pp. 117–135, Dec. 2019, doi: 10.1108/JSM-02-2019-0050.

[18] S. Rohadian and M. T. Amir, "Upaya Membangun Customer Engagement Melalui Media Sosial Instagram," *J. Entrep. Manag. Ind.*, vol. 2, no. 4, pp. 179–186, Dec. 2019, doi: 10.36782/jemi.v2i4.1925.

[19] Z. Zainol, N. F. Habidin, J. Osman, and R. Yahaya, "The Key Qualities of a Strong Customer Engagement in the Customer-Brand Relationship Context," *Int. J. Acad. Res. Bus. Soc. Sci.*, vol. 6, no. 12, pp. 211–224, Dec. 2016, doi: 10.6007/IJARBSS/v6-i12/2487.

[20] B. Bugaje, P. Rutherford, and M. Clifford, "A systems dynamics approach to the bottom-up simulation of residential appliance load," *Energy Build.*, vol. 247, p. 111164, Sep. 2021, doi: 10.1016/j.enbuild.2021.111164.

[21] D. P. Sahar, M. T. Afifudin, and A. B. R. Indah, "Analisis Investasi Kapal Dry-Bulk Carrier Dengan Menggunakan Sistem Dinamik," *ARIKA*, vol. 14, no. 2, pp. 93–100, Aug. 2020, doi: 10.30598/arika.2020.14.2.93.

[22] F. Cosenz and G. Noto, "A dynamic business modelling approach to design and experiment new business venture strategies," *Long Range Plann.*, vol. 51, no. 1, pp. 127–140, Feb. 2018, doi: 10.1016/j.lrp.2017.07.001.

[23] Y. Barlas, "Formal aspects of model validity and validation in system dynamics," *Syst. Dyn. Rev.*, vol. 12, no. 3, pp. 183–210, 1996, doi: 10.1002/(SICI)1099-1727(199623)12:3<183::AID-SDR103>3.0.CO;2-4.

[24] D. Octabriyantiningtyas and E. Suryani, "The Effect of Service Quality on T-Cash Customer Satisfaction using System Dynamics Framework," *J. Inf. Syst. Eng. Bus. Intell.*, vol. 5, no. 1, p. 76, Apr. 2019, doi: 10.20473/jisebi.5.1.76-84.

[25] E. Suryani, R. A. Hendrawan, and U. E. Rahmawati, *Model dan Simulasi Sistem Dinamik*. Sleman: Deepublish, 2020.

[26] N. Hajiheydari and S. B. Khakbaz, "Assessment of Long-Term Effects of Marketing Mix Policies : A System Dynamics Approach," *Int. J. Syst. Soc.*, vol. 2, no. 2, pp. 1–22, Jul. 2015, doi: 10.4018/IJSS.2015070101.

[27] Y.-H. Hsieh and Y.-H. Chou, "Modeling the impact of service innovation for small and medium enterprises: A system dynamics approach," *Simul. Model. Pract. Theory*, vol. 82, pp. 84–102, Mar. 2018, doi: 10.1016/j.simpat.2017.12.004.

[28] E. Crescitelli and J. B. Figueiredo, "Brand equity evolution: a system dynamics model," *BAR - Brazilian Adm. Rev.*, vol. 6, no. 2, pp. 101–117, Jun. 2009, doi: 10.1590/S1807-76922009000200003.

[29] L. M. Samryn, *Akuntansi Manajemen: Informasi Biaya untuk Mengendalikan Aktivitas Operasi & Investasi*. Jakarta: Gramedia, 2017.

[30] R. L. F. Coelho, D. S. de Oliveira, and M. I. S. de Almeida, "Does social media matter for post typology? Impact of post content on Facebook and Instagram metrics," *Online Inf. Rev.*, vol. 40, no. 4, pp. 458–471, Aug. 2016, doi: 10.1108/OIR-06-2015-0176.

[31] M. J. de B. Silva, S. A. de Farias, M. K. Grigg, and M. de L. de A. Barbosa, "Online Engagement and the Role of Digital Influencers in Product Endorsement on Instagram," *J. Relatsh. Mark.*, vol. 19, no. 2, pp. 133–163, Apr. 2020, doi: 10.1080/15332667.2019.1664872.

[32] Y. Barlas, "Multiple tests for validation of system dynamics type of simulation models," *Eur. J. Oper. Res.*, vol. 42, no. 1, pp. 59–87, Sep. 1989, doi: 10.1016/0377-2217(89)90059-3.

[33] J. B. Shao, W. Y. Xu, and J. H. Zhang, "The influence of brand extension on customer equity value of parent brand based on system dynamics," *Int. Conf. Manag. Sci. Eng. - Annu. Conf. Proc.*, vol. 2017-August, pp. 203–209, 2018, doi: 10.1109/ICMSE.2017.8574385.

[34] E. Suryani, G. A. Cahyandini, R. A. Hendrawan, M. A. Satrugna, U. E. Rahmawati, and R. Riski, "Model Scenario to Increase Market Share and Profitability of MSMEs through Business Process Digitalization," pp. 7–12, 2020.