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Small Medium Enterprise Social Media Ranking using Analytic Network Process

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Abstract— The development of technology requires people to use and utilize it, including Small Medium Enterprise (SMEs). Social media can be used to help digitally market various kinds of SME products without the need for the physical stores. The main challenge of the digital market is that not all SMEs have social media, they are hampered by ignorance and many other problems. Moreover, they tend to use social media that are familiar to their circle, even though several other social media also have good benefits but have not been used effectively. Therefore, this study aims to rank social media based on their level of engagement. There are four criteria used in the User Engagement Scale whichconsist of perceived usability, focused attention, attractive appeal, and reward factor. The ranking method used is the Analytic Network Process asall the existing criteria are connected. The results showed that of the five social media alternatives used, E-Commerce got the best ranking seen from the four sides of engagement with a value of 0.366.

Keywords—social media, ranking, small medium enterprise, analytic network process

I. Introduction

Social media is currently one of the supports for small medium enterprises (SME) to market their products digitally. According to Hanafizadeh [1] stated that social networking sites for instance, (WhatsApp, Line, Telegram, and WeChat), Content communities (example, YouTube, TikTok, Vimeo), Blogs (Twitter, Blogspot), and online forums and discussion (TripAdvisor, Yelp, and FourSquare) as the types of social media. Some of these social media are familiar to SMEs and are used to sell online. The continued growth of social networking sites and digital platforms is influencing the strategy for many small and medium-sized multinational companies, but also large conglomerates are affected by the development of the digital world [2].

In extending the span of the modernworldwide business sectors, digitalization enjoys a few benefits that were recently possessed by SMEs working in metropolitan regions contrasted with SMEs situated in rustic regions. For instance, digitization creates an expansion of the rural SMEs to gain the worldwide business contacts through web-based showcasing. Digitization has empowered the rural SMEs to use conveyance coordinated factors for their metropolitan partners to benefit a cutthroat benefit is calculated. A sizable impact can be seen on the relationship between customersand companies or business actors positively from the social media. This social media is used to connect customers and is something that must exist to support businesses so that they can still thrive with competitors [3]. Communication tools are established between SMEs and companies as a benefit from the social media, it provides the opportunities as an advertising tool for promotion of their activities or products [4].

The utilization of social media and all kinds of information technology is growing in SMEs as well as potential produced by SMEs for the economy of a country, this shows that Small and Medium Enterprises (SMEs) need viable solutions to expand market share. Social Media is one of the most powerful advertising media to gain this objective. With the various kinds of social media that exist today, it can be a good solution for the SME owners. However, the SMEs in Indonesia have yet to have a brand / name due to the concerns of the social media use as only around 15.08% of SMEs market sell their products online [5]. Moreover, another issue is that some have yet to discuss whether they can profit from maintaining an e-commerce business, since they have impediments in the space of plan, appropriation, showcasing, and post-deals support. Another issue is security, which makes SMEs or people wonder whether or not to make exchanges. Besides, ignorance of the information, communication and technology system is an obstacle, so numerous SMEs or people are reluctant to carry out transactions of the website [6].

The benefits of social media are expanded brand awareness and good corporate image and relationship management, appropriate brand correspondence, improved sales, competitive benefit, and unexpected gamble uncertainty [7]. The gap between successful and unsuccessful or non-adopters of social media is therefore widening, making it harder for non-adopters to survive in the long term [8]. Of all the benefits and problems that exist, to amplify the advantages of social media and to provide views to SMEs, a social media ranking is created. This can give SME owners an idea of which social media owners have the best engagement to use in marketing their products.

This ranking is based on the User Engagement Scale (UES) by Heather L. O'Brien which consists of four variables (focused attention, perceived usability, aesthetic appeal, and reward factor) [9]. These four variables will be the criteria for ranking social media. The method used in the ranking is the analytic network process (ANP). It is known that ANP is an advanced version of analytic hierarchy process which ranks by pairwise comparisons between criteria with objectives, criteria with criteria, criteria and alternatives, as well as between alternatives. In addition, ANP can also measure the relative importance of each interconnected interaction in the network [10]. Therefore, the main objective of this study is to create a rank between all forms of social media based on the level of engagement criterias.

II. Literature Review

A. Related Work

Research on ANP has studied many rankings in various areas. Research conducted by Ratapol Wudhikarn and

several others have discussed the selection decisions of the various new product formulas by combining the ANP with Monte Carlo. The criteria in this study are divided into three, quality, cost and formula. Each of these criteria is further divided into sub-criteria. The result for best alternatives is Formula A with sensitivity analysis in several scenarios given [11].

In addition, research was conducted by David Jorge-García Vicente and Estruch-Guitart on Comparative analysis between AHP and ANP in prioritization of ecosystem services - A case study in a rice field area raised in the Guadalquivir marshes (Spain). The researchers focused on finding priority ecosystem services in agricultural areas by comparing AHP and ANP. This study revealed that ANP was way more effectively applied to cases that require high accuracy. While AHP is not compared with other elements and if there are problems with certain criteria, it can be prioritized by increasing the level of importance [12].

Another study discussing ANP entitled Using the Analytical Network Process to Select the Best Strategy for Reducing Risks in a Supply Chain was conducted by L. Hosseini, R. Tavakkoli-Moghaddam, B. Vahdani, S. M. Mousavi, and R. Kia. This study focuses on how to choose the best strategy in the supply chain by considering five alternatives consisting of total quality management (TQM), leanness, alignment, adaptability, and agility. Meanwhile, the criteria that will be assessed are based on supply risk, process risk, demand risk, and disruption risk. Each of these criteria also has its own sub-criteria. The result is that one of the best strategies with the highest score is TQM with a value of 0.483 [13].

B. Social Media dan SME

Social media is characterized as an interactive platform which allows everyone to communicate with each other, can quickly share content on various digital platforms, such as smartphones, edit content or change it, and to comment, just view or like, and also share with each other. content shared by others. All of these things are shared on social media that are widely known by many people, some of which are Instagram, Facebook, YouTube, Twitter, and Linkedin [11].

Companies can promote and disseminate new products or services to customers and potential customers by utilizing social media, so that they can also create innovative business ideas [14]. Social media can also be utilized by organizations to produce, adjust, share and discuss internet content with customers globally [15]. Therefore, good customer engagement comes from using social media [16].

Businesses are increasingly taking advantage of the popularity of social media because it can be a liaison beyond personal conversations from individual to group and also to get feedback from customers [17]. Social media is also considered as a simple and powerful instrument for social connection building activities. Thus, using social media as an online business network can assist with expanding business support and make positive business performance and economic development, especially for rural SMEs [18]. Modern SMEs can profit from putting resources into mechanical advancements connected with Industry 4.0. Small-scale industries are characterized by flexible production, and proximity to customers forces them to continually adapt technology to suit products [19].

C. Analytic Network Process (ANP)

The ANP was created by Saaty in the late 1990s and expanded and enhanced the conventional AHP by thinking about dependence and feedback; in this way, it is known as a nonexclusive type of the analytical hierarchy process [11]. The method needs a hierarchical structure and element connection and does not acknowledge interdependence relationships in a group of variables [20]. The ANP technique goes past the straight relationship among components and approves the cooperation between components [21]. Rather than a hierarchy, the major ANP framework is a network that replaces single direct associations with dependencies and feedback [22]. Unlike AHP, which cannot be used for measurement in terms of the dependence between factors. ANP can handle decisions regarding the interdependence between decision levels and attributes by providing a common framework [23].

It lays out the similar significance of the criteria and ranks and the alternatives available in the model. ANP assists to evaluate collaboration between clusters and then further among factors within a cluster. ANP works with human judgment to manage withpriorities and compromises among goals and defines criteria for an issue. This method can be actually used when the criteria and alternatives are associated [24]. Support in decision making can take advantage of the analytic network process and also it can provide advantages in terms of assumptions whose variants are interdependent [25]. ANP consists of objectives, and has components similar to AHP where levels in AHP are replaced by clusters. Each cluster combines elements that have similar attributes. The relative importance score of the elements being compared is determined using a 1-to-9 scale [11].

There are six stages of ranking using analytic network process as follows [26]:

Step 1: Define criteria, build a network model and problem structure. In analytic network process, the first thing to do to solve the problems is to determine the criteria, objectives and alternatives. In this study, the aim is the ranking of social media. While the criteria used for the ranking are Focused Attention, Perceived Usability, Attractive Appeal, and Reward Factor according to the user engagement scale (UES) theory. Then the alternatives are Twitter, Facebook, Instagram, E-commerce, and Whatsapp.

Step 2: Create a pairwise comparison matrix and relative weights. This step involves the SME owner's view of the weight of each criterion. Pairwise comparisons were performed by assigning weights using the following Saaty weighting table [27]:

TABLE I. MATRIX SCALE

Scale	Definition
1	The same importance
3	Slightly more importance
5	Obviously more importance
7	More importance
9	Extremely more importance
2,4,6,8	The median value between two elements

Step 3: Consistency check, this step will influence the effectiveness of evaluation with consistency ratio (CR), random index (RI) and consistency index (CI). The accepted index value is when the CR value is < 0.1; or equal to 0, if the value exceeds this limit, then the pairwise comparison process will be repeated until it gets a consistent value.

$$CI = \frac{\lambda max - n}{n - 1} \quad (1)$$

$$CR = \frac{CI}{RI} \quad (2)$$

Random Index is a value whose purpose is to assess the consistency of the pairwise comparison matrix obtained and derived as an average RI. The RI value itself is obtained from the random consistency index table as shown in table 2 [23].

TABLE 2. RANDOM INDEX

n	1	2	3	4	5	6	7	8	9
RI	0	0	0,52	0,89	1,11	1,25	1,35	1,40	1,45

Step 4: Form and complete the supermatrix. The unweighted supermatrix is calculated by replacing the internal priority vectors (relative weights), elements and clusters. Then, there is an obligation to standardize the unweighted supermatrix to add up each column and construct the weighted supermatrix [28].

Step 5: Calculate the limited supermatrix. To calculate the limited supermatrix, the weighted supermatrix has to be sufficiently raised to a bigger power to deliver convergence, or at least, all elements of each row are required to be identical [29].

Step 6: Pick the best alternative based on the weight value. The best alternative is selected based on the greatest value of each alternative.

III. METHODS

Social media is widely used by SMEs to help them promote their products to many people. Currently there are various choices of social media to choose from. In this study, the output is a ranking of social media seen from user engagement, the following research stage detailed in Figure 1:

Fig. 1. The research stages.

Problem identification started since the pandemic emerged where the use of digital technology was increasing, especially the use of social media. Merchants are starting to change their sales patterns to digital because they anticipate physical encounters with customers. Buyers also change their shopping patterns to online shopping to facilitate the process of purchasing goods to avoid catching the virus. From this point, SME owners who initially did not understand digital technology at all were slowly forced to change their habits.

But in fact, there are still many SME owners who stick with conventional sales and have not switched to digital. In addition, those who already have social media cannot use it optimally, even though several social media have good engagement. This ranking is expected to provide insight to SME owners onwhich social media has the best engagement based on the weight of the UES criteria.

Data collection was carried out for approximately 2 months, from June to August online using the Google Form, or offline by going directly to the owner of the SME. The data were obtained from SME owners to get the weighting of the criteria as well as alternatives. In this study, there were 3 SMEs that became the data source for the weighting process. These SMEs were given the same question regarding pairwise comparisons and weighting according to the ANP step. The ANP was chosen because it can rank selected factors based on the relationship between criteria, alternatives and goals. In line with this, the case studies in this research are related to each other. The ANP will compare each element until the highest weight is found for each of these elements.

Prior to ranking, the weights for each criterion are calculated and compared in pairs. The comparison process is carried out between criteria with objectives, criteria with criteria, criteria with alternatives and alternatives with alternatives. From the comparison results, the consistency level and supermatrix value will be calculated. In general, the ranking process with ANP is shown in Figure 2:

The criteria in this study are user engagement scale variables consisting of Focused Attention (FA), Perceived Usability (PU), Aesthetic Appeal (AA) criteria, and Reward Factor (RF). While the alternative is social media which is widely used by users whose data is also obtained from distributing questionnaires. Of the nine existing social media, it was then narrowed down to the top 5 that were widely used. The five social media are Instagram, Twitter, Facebook, E-Commerce, and Whatsapp.

Fig. 2. ANP stages.

Pairwise comparison is completed by distributing the weighting questionnaires to SMEs. The SMEs are weighted based on their experience in using social media to market products. The comparative process that is significantly high can create inconsistencies in choosing the appropriate weighting. Therefore, there is a process called consistency check to find out how consistent the pairwise comparisons are. If it is inconsistent, then the calculation process must start from the beginning to get the consistent results. In

checking consistency, the value will be determined based on the consistency ratio as in formula (2).

Consistent results then proceed to the calculation stages of the matrix, supermatrix, and limited supermatrix. The results of these calculations are selected based on the highest value. This highest value is the output, where the social media with the highest value becomes the social media most widely used by SMEs based on the level of engagement.

IV. RESULTS

A. Comparing objectives with criteria, and between criteria and criteria

The selection criteria consisted of four variables that are adjusted to the variables on the User Engagement Scale (UES) which are Focused Attention, Perceived Usability, Aesthetic Appeal and Reward Factor. Unlike AHP, which is a simple hierarchy, in ANP the hierarchy is interconnected between criteria and alternatives. Therefore, the weighting points are more complex as per the ANP step. In this method there are also weighted, unweighted, and limited the supermatrix calculations, which are not present in the AHP calculation step. The hierarchy of social media rankings is shown in Figure 3. The hierarchy shows that the objectives are at the top, then below are the ranking criteria, and finally the ranking alternative to be chosen. This process is quite important because it is the initial stage in calculating ANP.

Fig. 3. Ranking hierarchy of social media.

This research aims to rank the social media. This goal will be compared with each of the criteria, namely Focused Attention, Perceived Usability, Aesthetic Appeal, and Reward Factor. Each of these criteria is also compared between each other. In addition, each criterion is compared again with the five alternatives, namely Twitter, Instagram, Facebook, E-Commerce, and Whatsapp. Table 3 shows the process of pairwise comparison between goals (social media rankings) and criteria. The value of this comparison may differ between SMEs. Several points explain that the FA is more important than the PU or vice versa. In this study, one data from one SME is displayed.

TABLE 3. PAIRWISE COMPARISON BETWEEN PURPOSE AND CRITERIA

	FA	PU	AA	RF
FA	1	2	3	1
PU	0,5	1	2	0,5
AA	0,33	0,5	1	0,33
RF	1	2	3	1
Total	2,83	5,5	9	2,83

TABLE 4. EIGENVECTOR VALUE

Criteria	FA	PU	AA	RF	Eigenvector
FA	0,35	0,36	0,33	0,35	0,35
PU	0,18	0,18	0,22	0,18	0,19
AA	0,12	0,09	0,11	0,12	0,11
RF	0,35	0,36	0,33	0,35	0,35
Total	1	1	1	1	

TABLE 5. CONSISTENCY CHECK

	FA	PU	AA	RF	Hasil	λ_{max}	CI	CR
FA	0,35	0,36	0,33	0,35	1,41	1	0	0
PU	0,18	0,18	0,22	0,18	0,76	1		
AA	0,12	0,09	0,11	0,12	0,44	1		
RF	0,35	0,36	0,33	0,35	1,41	1		
Total						4,01		

The eigenvector is obtained by calculating the average value of each paired comparison as shown in table 4. Due to the consistency check as expected, which is less than 0.1, it can be concluded that this comparison is consistent and can be continued to the next stage. After that is a comparison between criteria with criteria. The first criterion that is compared is Focused Attention as shown in table 5. The total score is obtained from calculating the the total values of FA, PU, AA, and RF. Meanwhile, consistency checks were carried out using the CI and CR formulas. The final result of CR obtained is 0 so the results are consistent.

B. Comparison between criteria and alternatives

The alternative in this research is the social media widely used either by buyer or SME. Of the several existing social media, there are five important platforms that are the main focus of this research, namely Twitter, Facebook, Instagram, E-Commerce, and Whatsapp. These five alternatives are then compared with the four criteria. To make it easier to mention in the table, Twitter will be abbreviated as T, Instagram (I), Facebook (F), E-Commerce (E), and Whatsapp (W).

TABLE 6. PAIRWISE COMPARISON BETWEEN FOCUSED ATTENTION AND ALTERNATIVES

FA	T	I	F	E	W
T	1	0,33	0,25	0,33	0,5
I	3	1	0,5	1	2
F	4	2	1	2	3
E	3	1	0,5	1	2
W	2	0,5	0,33	0,5	1
Total	13	4,83	2,58	4,83	8,5

TABLE 7. EIGENVACTOR VALUE FOR ALTERNATIVES

FA	T	I	F	E	W	Eigen
T	0,08	0,07	0,1	0,07	0,06	0,07
I	0,23	0,21	0,19	0,21	0,24	0,21
F	0,31	0,41	0,39	0,41	0,35	0,38
E	0,23	0,21	0,19	0,21	0,24	0,21
W	0,15	0,1	0,13	0,1	0,12	0,12
Total	1	1	1	1	1	

TABLE 8. CONSISTENCY CHECK FOR ALTERNATIVES PAIRWISE COMPARISON

FA	T	I	F	E	W	λ_{max}	CI	CR
T	0,08	0,07	0,1	0,07	0,06	1	0,01	0,01
I	0,23	0,21	0,19	0,21	0,24	1,01		
F	0,31	0,41	0,39	0,41	0,35	1,01		

E	0,23	0,21	0,19	0,21	0,24	1,01		
W	0,15	0,1	0,13	0,1	0,12	1		
Sum						5,03		

The pairwise comparison is conducted to all the criteria and alternative as shown in table 6. In this table the comparison is between focused attention criteria and five alternatives (Twitter, Facebook, Instagram, E-Commerce, and Whatsapp). The eigenvector values in table 7 are obtained from the average of the total values per row. In addition, the total is also obtained from calculating the total of each column. The consistency check shown in table 8 also gets consistent results because the value is < 0.1.

C. Pairwise comparison between alternatives and alternatives

The five alternatives were compared with each other to find out which SMEs prioritized the most as shown in table 9. The formula used is the same as before. The following table (10 and 11) were a pairwise comparison table for alternatives, it was between Twitter, Facebook, Instagram, E-commerce, and Whatsapp.

TABEL 9. PAIRWISE COMPARISON BETWEEN ALTENATIVES

Alternatives	T	I	F	E	W
T	1	0,14	0,33	0,11	0,5
I	7	1	5	0,33	2
F	3	0,2	1	0,14	3
E	9	3	7	1	2
W	5	0,33	3	0,2	1
Total	25	4,68	16,33	1,79	8,5

TABLE 10. EIGENVECTOR VALUE FOR ALTERNATIVES

Alt	T	I	F	E	W	Eigen
T	0,04	0,03	0,02	0,06	0,02	0,03
I	0,28	0,21	0,31	0,19	0,31	0,26
F	0,12	0,04	0,06	0,08	0,03	0,07
E	0,36	0,64	0,43	0,56	0,52	0,21p
W	0,2	0,07	0,18	0,11	0,1	0,12
Total	1	1	1	1	1	

TABLE 11. CONSISCTENCY CHECK FOR ALTERNATIVES PAIRWISE COMPARISON

Alt	T	I	F	E	W	λ_{max}	CI	CR
T	0,03	0,04	0,02	0,06	0,03	1,02	0,06	0,05
I	0,24	0,26	0,34	0,17	0,4	1,09		
F	0,1	0,05	0,07	0,04	0,04	1,01		
E	0,31	0,78	0,47	0,47	0,67	1,09		
W	0,17	0,09	0,2	0,2	0,13	1,04		
Sum						5,03		

D. Calculate the unweighted, weigthed, and limited supermatrix

The following table is the result of the calculation of the unweighted supermatrix. This value as shown in table 12 is obtained from pairwise comparisons that have been carried out in the previous stage. Then in the weighted supermatrix the value is obtained from the results of the calculation between the eigenvalues and the unweighted supermatrix, so the results are shown in table 13.

TABLE 12. UNWEIGHTED SUPERMATRIX

Alternatives	T	I	F	E	W
T	1	0,1	0,1	0,1	0,14
I	0,23	1	0,28	0,47	0,26
F	0,12	0,28	1	0,28	0,14
E	0,42	0,47	0,47	1	0,45
W	0,23	0,16	0,16	0,16	1
Total	2	2	2	2	

TABLE 13. WEIGHTED SUPERMATRIX

Alt	T	I	F	E	W	Results	Total
T	0,035	0,025	0,007	0,048	0,019	0,134	0,067
I	0,008	0,26	0,019	0,234	0,035	0,556	0,278
F	0,004	0,072	0,068	0,139	0,019	0,302	0,151
E	0,015	0,121	0,032	0,503	0,061	0,731	0,366
W	0,008	0,042	0,011	0,081	0,134	0,276	0,138
Total						2	1

TABLE 14. LIMITED SUPERMATRIX

Alt	T	I	F	E	W	Total
T	0,004	0,019	0,01	0,024	0,009	0,067
I	0,019	0,077	0,042	0,102	0,038	0,278
F	0,01	0,042	0,023	0,055	0,021	0,151
E	0,024	0,102	0,055	0,134	0,05	0,366
W	0,009	0,038	0,021	0,05	0,019	0,138
Total	0,067	0,278	0,151	0,366	0,138	1

From all the results of these calculations then look for the highest value. The total of the limited supermatrix is shown in table 14. The highest rank is the one with the highest value. The highest score from the social media is E-Commerce with a total score of 0.366. To put it in the nutshell, as illustrates in Figure 4, the ranking of social media when viewed from the category of UES is E-Commerce.

Fig. 4. Social media ranking result

Based on calculations like the picture above, one level below e-commerce is Instagram, which is one of the SMEs owner favorites because it is image-based. Then followed by Facebook with a value of 0.15, Whatsapp with 0.13, and finally Twitter with a value of 0.06. The results of social media ranking were basically lead SMEs owner to open up and try another social media to market their product and make it as a consideration. In addition to theoritical implication, ANP is suitable for solving problems in which criteria and alternatives are interconnected in a network. Simple problems can use AHP, while problems that have a broad and complex scope can use ANP. However, ANP also

has limitations that cannot overcome the problem of uncertainty in the criteria.

V. CONCLUSIONS

This study discusses the ranking of social media based on four categories of user engagement scale. The determination of the weight for the ranking is obtained from interviews with SME owners who have used social media for marketing their business products. From the results of calculations using ANP, the ranking results are that e-commerce becomes social media which they think is good in terms of engagement. The limitation in this study is that the weighting is carried out with majority of older SME owners, which tend to affects the weighting results because there are definitely differences in views for young and old owners. Further research is that the weighting process can be done to various respondent, ranging from 20 until above 50 years old, to get many perspectives of each generation.

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Small Medium Enterprise Social Media Ranking using Analytic Network Process

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Abstract— **The development of technology requires people to use and utilize it, including Small Medium Enterprise (SMEs). Social media can be used to help digitally market various kinds of SME products without the need for the physical stores. The main challenge of the digital market is that not all SMEs have social media, they are hampered by ignorance and many other problems. Moreover, they tend to use social media that are familiar to their circle, even though several other social media also have good benefits but have not been used effectively. Therefore, this study aims to rank social media based on their level of engagement. There are four criteria used in the User Engagement Scale whichconsist of perceived usability, focused attention, attractive appeal, and reward factor. The ranking method used is the Analytic Network Process asall the existing criteria are connected. The results showed that of the five social media alternatives used, E-Commerce got the best ranking seen from the four sides of engagement with a value of 0.366.**

Keywords—social media, ranking, small medium enterprise, analytic network process

I. INTRODUCTION

Social media is currently one of the supports for small medium enterprises (SME) to market their products digitally. According to Hanafizadeh [1] stated that social networking sites for instance, (WhatsApp, Line, Telegram, and WeChat), Content communities (example, YouTube, TikTok, Vimeo), Blogs (Twitter, Blogspot), and online forums and discussion (TripAdvisor, Yelp, and FourSquare) as the types of social media. Some of these social media are familiar to SMEs and are used to sell online. The continued growth of social networking sites and digital platforms is influencing the strategy for many small and medium-sized multinational companies, but also large conglomerates are affected by the development of the digital world [2].

In extending the span of the modernworldwide business sectors, digitalization enjoys a few benefits that were recently possessed by SMEs working in metropolitan regions contrasted with SMEs situated in rustic regions. For instance, digitization creates an expansion of the rural SMEs to gain the worldwide business contacts through web-based showcasing. Digitization has empowered the rural SMEs to use conveyance coordinated factors for their metropolitan partners to benefit a cutthroat benefit is calculated. A sizable impact can be seen on the relationship between customersand companies or business actors positively from the social media. This social media is used to connect customers and is something that must exist to support businesses so that they can still thrive with competitors [3]. Communication tools are established between SMEs and companies as a benefit from the social media, it provides the opportunities as an advertising tool for promotion of their activities or products [4].

The utilization of social media and all kinds of information technology is growing in SMEs as well as potential produced by SMEs for the economy of a country, this shows that Small and Medium Enterprises (SMEs) need viable solutions to expand market share. Social Media is one of the most powerful advertising media to gain this objective. With the various kinds of social media that exist today, it can be a good solution for the SME owners. However, the SMEs in Indonesia have yet to have a brand / name due to the concerns of the social media use as only around 15.08% of SMEs market sell their products online [5]. Moreover, another issue is that some have yet to discuss whether they can profit from maintaining an e-commerce business, since they have impediments in the space of plan, appropriation, showcasing, and post-deals support. Another issue is security, which makes SMEs or people wonder whether or not to make exchanges. Besides, ignorance of the information, communication and technology system is an obstacle, so numerous SMEs or people are reluctant to carry out transactions of the website [6].

The benefits of social media are expanded brand awareness and good corporate image and relationship management, appropriate brand correspondence, improved sales, competitive benefit, and unexpected gamble uncertainty [7]. The gap between successful and unsuccessful or non-adopters of social media is therefore widening, making it harder for non-adopters to survive in the long term [8]. Of all the benefits and problems that exist, to amplify the advantages of social media and to provide views to SMEs, a social media ranking is created. This can give SME owners an idea of which social media owners have the best engagement to use in marketing their products.

This ranking is based on the User Engagement Scale (UES) by Heather L. O'Brien which consists of four variables (focused attention, perceived usability, aesthetic appeal, and reward factor) [9]. These four variables will be the criteria for ranking social media. The method used in the ranking is the analytic network process (ANP). It is known that ANP is an advanced version of analytic hierarchy process which ranks by pairwise comparisons between criteria with objectives, criteria with criteria, criteria and alternatives, as well as between alternatives. In addition, ANP can also measure the relative importance of each interconnected interaction in the network [10]. Therefore, the main objective of this study is to create a rank between all forms of social media based on the level of engagement criterias.

II. LITERATURE REVIEW

A. Related Work

Research on ANP has studied many rankings in various areas. Research conducted by Ratapol Wudhikarn and

several others have discussed the selection decisions of the various new product formulas by combining the ANP with Monte Carlo. The criteria in this study are divided into three, quality, cost and formula. Each of these criteria is further divided into sub-criteria. The result for best alternatives is Formula A with sensitivity analysis in several scenarios given [11].

In addition, research was conducted by David Jorge-García Vicente and Estruch-Guitart on Comparative analysis between AHP and ANP in prioritization of ecosystem services - A case study in a rice field area raised in the Guadalquivir marshes (Spain). The researchers focused on finding priority ecosystem services in agricultural areas by comparing AHP and ANP. This study revealed that ANP was way more effectively applied to cases that require high accuracy. While AHP is not compared with other elements and if there are problems with certain criteria, it can be prioritized by increasing the level of importance [12].

Another study discussing ANP entitled Using the Analytical Network Process to Select the Best Strategy for Reducing Risks in a Supply Chain was conducted by L. Hosseini, R. Tavakkoli-Moghaddam, B. Vahdani, S. M. Mousavi, and R. Kia. This study focuses on how to choose the best strategy in the supply chain by considering five alternatives consisting of total quality management (TQM), leanness, alignment, adaptability, and agility. Meanwhile, the criteria that will be assessed are based on supply risk, process risk, demand risk, and disruption risk. Each of these criteria also has its own sub-criteria. The result is that one of the best strategies with the highest score is TQM with a value of 0.483 [13].

B. Social Media dan SME

Social media is characterized as an interactive platform which allows everyone to communicate with each other, can quickly share content on various digital platforms, such as smartphones, edit content or change it, and to comment, just view or like, and also share with each other. content shared by others. All of these things are shared on social media that are widely known by many people, some of which are Instagram, Facebook, YouTube, Twitter, and Linkedin [11].

Companies can promote and disseminate new products or services to customers and potential customers by utilizing social media, so that they can also create innovative business ideas [14]. Social media can also be utilized by organizations to produce, adjust, share and discuss internet content with customers globally [15]. Therefore, good customer engagement comes from using social media [16].

Businesses are increasingly taking advantage of the popularity of social media because it can be a liaison beyond personal conversations from individual to group and also to get feedback from customers [17]. Social media is also considered as a simple and powerful instrument for social connection building activities. Thus, using social media as an online business network can assist with expanding business support and make positive business performance and economic development, especially for rural SMEs [18]. Modern SMEs can profit from putting resources into mechanical advancements connected with Industry 4.0. Small-scale industries are characterized by flexible

production, and proximity to customers forces them to continually adapt technology to suit products [19].

C. Analytic Network Process (ANP)

The ANP was created by Saaty in the late 1990s and expanded and enhanced the conventional AHP by thinking about dependence and feedback; in this way, it is known as a nonexclusive type of the analytical hierarchy process [11]. The method needs a hierarchical structure and element connection and does not acknowledge interdependence relationships in a group of variables [20]. The ANP technique goes past the straight relationship among components and approves the cooperation between components [21]. Rather than a hierarchy, the major ANP framework is a network that replaces single direct associations with dependencies and feedback [22]. Unlike AHP, which cannot be used for measurement in terms of the dependence between factors. ANP can handle decisions regarding the interdependence between decision levels and attributes by providing a common framework [23].

It lays out the similar significance of the criteria and ranks and the alternatives available in the model. ANP assists to evaluate collaboration between clusters and then further among factors within a cluster. ANP works with human judgment to manage withpriorities and compromises among goals and defines criteria for an issue. This method can be actually used when the criteria and alternatives are associated [24]. Support in decision making can take advantage of the analytic network process and also it can provide advantages in terms of assumptions whose variants are interdependent [25]. ANP consists of objectives, and has components similar to AHP where levels in AHP are replaced by clusters. Each cluster combines elements that have similar attributes. The relative importance score of the elements being compared is determined using a 1-to-9 scale [11].

There are six stages of ranking using analytic network process as follows [26]:

Step 1: Define criteria, build a network model and problem structure. In analytic network process, the first thing to do to solve the problems is to determine the criteria, objectives and alternatives. In this study, the aim is the ranking of social media. While the criteria used for the ranking are Focused Attention, Perceived Usability, Attractive Appeal, and Reward Factor according to the user engagement scale (UES) theory. Then the alternatives are Twitter, Facebook, Instagram, E-commerce, and Whatsapp.

Step 2: Create a pairwise comparison matrix and relative weights. This step involves the SME owner's view of the weight of each criterion. Pairwise comparisons were performed by assigning weights using the following Saaty weighting table [27]:

TABLE I. MATRIX SCALE

Scale	Definition
1	The same importance
3	Slightly more importance
5	Obviously more importance
7	More importance
9	Extremely more importance
2,4,6,8	The median value between two elements

Step 3: Consistency check, this step will influence the effectiveness of evaluation with consistency ratio (CR), random index (RI) and consistency index (CI). The accepted index value is when the CR value is < 0.1; or equal to 0, if the value exceeds this limit, then the pairwise comparison process will be repeated until it gets a consistent value.

$$CI = \frac{\lambda max - n}{n - 1} \qquad (1)$$

$$CR = \frac{CI}{RI} \qquad (2)$$

Random Index is a value whose purpose is to assess the consistency of the pairwise comparison matrix obtained and derived as an average RI. The RI value itself is obtained from the random consistency index table as shown in table 2 [23].

TABLE 2. RANDOM INDEX

n	1	2	3	4	5	6	7	8	9
RI	0	0	0,52	0,89	1,11	1,25	1,35	1,40	1,45

Step 4: Form and complete the supermatrix. The unweighted supermatrix is calculated by replacing the internal priority vectors (relative weights), elements and clusters. Then, there is an obligation to standardize the unweighted supermatrix to add up each column and construct the weighted supermatrix [28].

Step 5: Calculate the limited supermatrix. To calculate the limited supermatrix, the weighted supermatrix has to be sufficiently raised to a bigger power to deliver convergence, or at least, all elements of each row are required to be identical [29].

Step 6: Pick the best alternative based on the weight value. The best alternative is selected based on the greatest value of each alternative.

III. METHODS

Social media is widely used by SMEs to help them promote their products to many people. Currently there are various choices of social media to choose from. In this study, the output is a ranking of social media seen from user engagement, the following research stage detailed in Figure 1:

Fig. 1. The research stages.

Problem identification started since the pandemic emerged where the use of digital technology was increasing, especially the use of social media. Merchants are starting to change their sales patterns to digital because they anticipate physical encounters with customers. Buyers also change their shopping patterns to online shopping to facilitate the process of purchasing goods to avoid catching the virus. From this point, SME owners who initially did not understand digital technology at all were slowly forced to change their habits.

But in fact, there are still many SME owners who stick with conventional sales and have not switched to digital. In addition, those who already have social media cannot use it optimally, even though several social media have good engagement. This ranking is expected to provide insight to SME owners onwhich social media has the best engagement based on the weight of the UES criteria.

Data collection was carried out for approximately 2 months, from June to August online using the Google Form, or offline by going directly to the owner of the SME. The data were obtained from SME owners to get the weighting of the criteria as well as alternatives. In this study, there were 3 SMEs that became the data source for the weighting process. These SMEs were given the same question regarding pairwise comparisons and weighting according to the ANP step. The ANP was chosen because it can rank selected factors based on the relationship between criteria, alternatives and goals. In line with this, the case studies in this research are related to each other. The ANP will compare each element until the highest weight is found for each of these elements.

Prior to ranking, the weights for each criterion are calculated and compared in pairs. The comparison process is carried out between criteria with objectives, criteria with criteria, criteria with alternatives and alternatives with alternatives. From the comparison results, the consistency level and supermatrix value will be calculated. In general, the ranking process with ANP is shown in Figure 2:

The criteria in this study are user engagement scale variables consisting of Focused Attention (FA), Perceived Usability (PU), Aesthetic Appeal (AA) criteria, and Reward Factor (RF). While the alternative is social media which is widely used by users whose data is also obtained from distributing questionnaires. Of the nine existing social media, it was then narrowed down to the top 5 that were widely used. The five social media are Instagram, Twitter, Facebook, E-Commerce, and Whatsapp.

Fig. 2. ANP stages.

Pairwise comparison is completed by distributing the weighting questionnaires to SMEs. The SMEs are weighted based on their experience in using social media to market products. The comparative process that is significantly high can create inconsistencies in choosing the appropriate weighting. Therefore, there is a process called consistency check to find out how consistent the pairwise comparisons are. If it is inconsistent, then the calculation process must start from the beginning to get the consistent results. In

checking consistency, the value will be determined based on the consistency ratio as in formula (2).

Consistent results then proceed to the calculation stages of the matrix, supermatrix, and limited supermatrix. The results of these calculations are selected based on the highest value. This highest value is the output, where the social media with the highest value becomes the social media most widely used by SMEs based on the level of engagement.

IV. RESULTS

A. Comparing objectives with criteria, and between criteria and criteria

The selection criteria consisted of four variables that are adjusted to the variables on the User Engagement Scale (UES) which are Focused Attention, Perceived Usability, Aesthetic Appeal and Reward Factor. Unlike AHP, which is a simple hierarchy, in ANP the hierarchy is interconnected between criteria and alternatives. Therefore, the weighting points are more complex as per the ANP step. In this method there are also weighted, unweighted, and limited the supermatrix calculations, which are not present in the AHP calculation step. The hierarchy of social media rankings is shown in Figure 3. The hierarchy shows that the objectives are at the top, then below are the ranking criteria, and finally the ranking alternative to be chosen. This process is quite important because it is the initial stage in calculating ANP.

Fig. 3. Ranking hierarchy of social media.

This research aims to rank the social media. This goal will be compared with each of the criteria, namely Focused Attention, Perceived Usability, Aesthetic Appeal, and Reward Factor. Each of these criteria is also compared between each other. In addition, each criterion is compared again with the five alternatives, namely Twitter, Instagram, Facebook, E-Commerce, and Whatsapp. Table 3 shows the process of pairwise comparison between goals (social media rankings) and criteria. The value of this comparison may differ between SMEs. Several points explain that the FA is more important than the PU or vice versa. In this study, one data from one SME is displayed.

TABLE 3. PAIRWISE COMPARISON BETWEEN PURPOSE AND CRITERIA

	FA	PU	AA	RF
FA	1	2	3	1
PU	0,5	1	2	0,5
AA	0,33	0,5	1	0,33
RF	1	2	3	1
Total	2,83	5,5	9	2,83

TABLE 4. EIGENVECTOR VALUE

Criteria	FA	PU	AA	RF	Eigenvector
FA	0,35	0,36	0,33	0,35	0,35
PU	0,18	0,18	0,22	0,18	0,19
AA	0,12	0,09	0,11	0,12	0,11
RF	0,35	0,36	0,33	0,35	0,35
Total	1	1	1	1	

TABLE 5. CONSISTENCY CHECK

	FA	PU	AA	RF	Hasil	λ_{max}	CI	CR
FA	0,35	0,36	0,33	0,35	1,41	1	0	0
PU	0,18	0,18	0,22	0,18	0,76	1		
AA	0,12	0,09	0,11	0,12	0,44	1		
RF	0,35	0,36	0,33	0,35	1,41	1		
Total						4,01		

The eigenvector is obtained by calculating the average value of each paired comparison as shown in table 4. Due to the consistency check as expected, which is less than 0.1, it can be concluded that this comparison is consistent and can be continued to the next stage. After that is a comparison between criteria with criteria. The first criterion that is compared is Focused Attention as shown in table 5. The total score is obtained from calculating the the total values of FA, PU, AA, and RF. Meanwhile, consistency checks were carried out using the CI and CR formulas. The final result of CR obtained is 0 so the results are consistent.

B. Comparison between criteria and alternatives

The alternative in this research is the social media widely used either by buyer or SME. Of the several existing social media, there are five important platforms that are the main focus of this research, namely Twitter, Facebook, Instagram, E-Commerce, and Whatsapp. These five alternatives are then compared with the four criteria. To make it easier to mention in the table, Twitter will be abbreviated as T, Instagram (I), Facebook (F), E-Commerce (E), and Whatsapp (W).

TABLE 6. PAIRWISE COMPARISON BETWEEN FOCUSED ATTENTION AND ALTERNATIVES

FA	T	I	F	E	W
T	1	0,33	0,25	0,33	0,5
I	3	1	0,5	1	2
F	4	2	1	2	3
E	3	1	0,5	1	2
W	2	0,5	0,33	0,5	1
Total	13	4,83	2,58	4,83	8,5

TABLE 7. EIGENVACTOR VALUE FOR ALTERNATIVES

FA	T	I	F	E	W	Eigen
T	0,08	0,07	0,1	0,07	0,06	0,07
I	0,23	0,21	0,19	0,21	0,24	0,21
F	0,31	0,41	0,39	0,41	0,35	0,38
E	0,23	0,21	0,19	0,21	0,24	0,21
W	0,15	0,1	0,13	0,1	0,12	0,12
Total	1	1	1	1	1	

TABLE 8. CONSISTENCY CHECK FOR ALTERNATIVES PAIRWISE COMPARISON

FA	T	I	F	E	W	λ_{max}	CI	CR
T	0,08	0,07	0,1	0,07	0,06	1	0,01	0,01
I	0,23	0,21	0,19	0,21	0,24	1,01		
F	0,31	0,41	0,39	0,41	0,35	1,01		

E	0,23	0,21	0,19	0,21	0,24	1,01		
W	0,15	0,1	0,13	0,1	0,12	1		
Sum						5,03		

The pairwise comparison is conducted to all the criteria and alternative as shown in table 6. In this table the comparison is between focused attention criteria and five alternatives (Twitter, Facebook, Instagram, E-Commerce, and Whatsapp). The eigenvector values in table 7 are obtained from the average of the total values per row. In addition, the total is also obtained from calculating the total of each column. The consistency check shown in table 8 also gets consistent results because the value is < 0.1.

C. Pairwise comparison between alternatives and alternatives

The five alternatives were compared with each other to find out which SMEs prioritized the most as shown in table 9. The formula used is the same as before. The following table (10 and 11) were a pairwise comparison table for alternatives, it was between Twitter, Facebook, Instagram, E-commerce, and Whatsapp.

TABEL 9. PAIRWISE COMPARISON BETWEEN ALTENATIVES

Alternatives	T	I	F	E	W
T	1	0,14	0,33	0,11	0,5
I	7	1	5	0,33	2
F	3	0,2	1	0,14	3
E	9	3	7	1	2
W	5	0,33	3	0,2	1
Total	25	4,68	16,33	1,79	8,5

TABLE 10. EIGENVECTOR VALUE FOR ALTERNATIVES

Alt	T	I	F	E	W	Eigen
T	0,04	0,03	0,02	0,06	0,02	0,03
I	0,28	0,21	0,31	0,19	0,31	0,26
F	0,12	0,04	0,06	0,08	0,03	0,07
E	0,36	0,64	0,43	0,56	0,52	0,21p
W	0,2	0,07	0,18	0,11	0,1	0,12
Total	1	1	1	1	1	

TABLE 11. CONSISCTENCY CHECK FOR ALTERNATIVES PAIRWISE COMPARISON

Alt	T	I	F	E	W	λmax	CI	CR
T	0,03	0,04	0,02	0,06	0,03	1,02	0,06	0,05
I	0,24	0,26	0,34	0,17	0,4	1,09		
F	0,1	0,05	0,07	0,04	0,04	1,01		
E	0,31	0,78	0,47	0,47	0,67	1,09		
W	0,17	0,09	0,2	0,2	0,13	1,04		
Sum						5,03		

D. Calculate the unweighted, weigthed, and limited supermatrix

The following table is the result of the calculation of the unweighted supermatrix. This value as shown in table 12 is obtained from pairwise comparisons that have been carried out in the previous stage. Then in the weighted supermatrix the value is obtained from the results of the calculation between the eigenvalues and the unweighted supermatrix, so the results are shown in table 13.

TABLE 12. UNWEIGHTED SUPERMATRIX

Alternatives	T	I	F	E	W
T	1	0,1	0,1	0,1	0,14
I	0,23	1	0,28	0,47	0,26
F	0,12	0,28	1	0,28	0,14
E	0,42	0,47	0,47	1	0,45
W	0,23	0,16	0,16	0,16	1
Total	2	2	2	2	

TABLE 13. WEIGHTED SUPERMATRIX

Alt	T	I	F	E	W	Results	Total
T	0,035	0,025	0,007	0,048	0,019	0,134	0,067
I	0,008	0,26	0,019	0,234	0,035	0,556	0,278
F	0,004	0,072	0,068	0,139	0,019	0,302	0,151
E	0,015	0,121	0,032	0,503	0,061	0,731	0,366
W	0,008	0,042	0,011	0,081	0,134	0,276	0,138
Total						2	1

TABLE 14. LIMITED SUPERMATRIX

Alt	T	I	F	E	W	Total
T	0,004	0,019	0,01	0,024	0,009	0,067
I	0,019	0,077	0,042	0,102	0,038	0,278
F	0,01	0,042	0,023	0,055	0,021	0,151
E	0,024	0,102	0,055	0,134	0,05	0,366
W	0,009	0,038	0,021	0,05	0,019	0,138
Total	0,067	0,278	0,151	0,366	0,138	1

From all the results of these calculations then look for the highest value. The total of the limited supermatrix is shown in table 14. The highest rank is the one with the highest value. The highest score from the social media is E-Commerce with a total score of 0.366. To put it in the nutshell, as illustrates in Figure 4, the ranking of social media when viewed from the category of UES is E-Commerce.

Fig. 4. Social media ranking result

Based on calculations like the picture above, one level below e-commerce is Instagram, which is one of the SMEs owner favorites because it is image-based. Then followed by Facebook with a value of 0.15, Whatsapp with 0.13, and finally Twitter with a value of 0.06. The results of social media ranking were basically lead SMEs owner to open up and try another social media to market their product and make it as a consideration. In addition to theoritical implication, ANP is suitable for solving problems in which criteria and alternatives are interconnected in a network. Simple problems can use AHP, while problems that have a broad and complex scope can use ANP. However, ANP also

has limitations that cannot overcome the problem of uncertainty in the criteria.

V. CONCLUSIONS

This study discusses the ranking of social media based on four categories of user engagement scale. The determination of the weight for the ranking is obtained from interviews with SME owners who have used social media for marketing their business products. From the results of calculations using ANP, the ranking results are that e-commerce becomes social media which they think is good in terms of engagement. The limitation in this study is that the weighting is carried out with majority of older SME owners, which tend to affects the weighting results because there are definitely differences in views for young and old owners. Further research is that the weighting process can be done to various respondent, ranging from 20 until above 50 years old, to get many perspectives of each generation.

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