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Media Social based Smart DSM for Strategic Decision Making: Waste Management Case

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Abstract*: Social media is a fact. It grows rapidly. It is not only as a communication media, but also for information exchange. One of them is Twitter. It is text-based sharing media among its users. Based on all categories of sentiment interchanged in Twitter media, central issue could be academically addressed; then, it is able to be methodically converted to become a decision support model (DSM) that is operated to solve the strategic decision problem. Here, "waste' issues were addressed and interconnected insight-parameters were defined. Then, a DSM constructed. Combination of methods fuzzy logic and mathematic successfully used as a main approach of the model. The constructed model is finally able to evaluate a quality of waste management in Indonesia and propose an actionable decision for answering the challenge of waste in Indonesia.

***Keywords*: social media, Twitter, decision support model, strategic decision making, waste management.**

I. INTRODUCTION

Social media was assimilated into the millions of people's lives [1] and used popularly by population majority [2]. Information sharing and communicating are practically and easily facilitated by social media. Millions data and information are interchanged each and every time that could be scientifically benefited as a sign and pointer for answering the problem.

The studies increased correlating such a social media [3]. Surely in informatics specific domain as creator of this media and also in others. Logically, a social media was functioned to find highlighted information and data to analyze and learn then.Several researchers conducted a study via social media as a media for collecting the issue are [4], [5], [6], and [7]. [4] conducted a study to scrape all data coming from Twitter users' tweet for predicting sale behavior and tax-income in Indonesia. Scraping machine has been successfully developed and tested via this study.In addition [5] analyzed the social media users' behavior. It was functioned for understanding the dissemination pattern of urological information. The social media analytic implication also was discussed in this study. The aim was to foster the better understanding of social media imperative facets.Furthermore, [6] studied and evaluated the connection between government and social media, particularly in 49 African countries. The quantile-regression was method operated in the study. The findings presented that the Facebook penetration was positive interconnecting government dynamics. Then [7] also used social media in their study. [7] tried to assess the academic program thru social media. The new method to measure was proposed. Here, LinkedIn operated to analyze the posts made from more than 100 students. The students' profile also functioned to see the feasibility of the offered method. Based on the imperative background, this study was performed. The study was conducted to capture the insight of waste from social media and construct a smart decision support model (smart DSM) to propose solutions to solve the problem regarding waste and waste management in Indonesia. Intense analysis, fuzzy logic, and mathematical approach were operated to become main methods used in constructing the model. The model finally was able to suggest the objective decision for answering the problem. Finally, the paper consists of five parts. They are introduction, related works, research methodology, result and discussion, and conclusion and further works. The parts respectively represent a state of the art of study, interconnected works ever done, research methods performed in the research, the result of study and model experimental result, and conclusion of study and further works should be performed by next researchers.

II. RELATED WORKS

DSM as a key area of research was functioned by numerous scientists. [8] constructed a fuzzy based DSM for treating medical waste. DSM established by combining three methods; i.e. fuzzy logic, distance Euclidean calculation, and full-factorial optimization. The model suggested the best decision as the objective decision to treat waste in one hospital in Jakarta, Indonesia.[9] developed a novel DSM for municipal solid waste management. The study was conducted in Taiwan. Several parameters considered in the model were social factor, environmental effects, technical issue, and management aspect. The model developed to solve a problem regarding insufficiency in solid waste management. urthermore, [10] functioned a DSM for evaluating the quality of sewage treated in a septic tank and a vertical flow filter. The model also was able to select waste material. Two methods were used here, they were artificial neural network and principal component analysis. Moreover, [11] constructed a DSM for evaluating a pathway of waste-to-energy particularly in New South Wales, Australia.

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The model predicted that 854 GWh renewable energy could be produced via waste-to-energy pathway in 2036.

III. RESEARCH METHODOLOGY

Five stages are performed to do the study (see Fig. 1.). As usual, for accomplishing a research, literature study is performed firstly. So, the holistic knowledge of research topic is obtained. Online literature database (e.g. sciencedirect.com) is functioned to search related literatures and be deeply reviewed then.

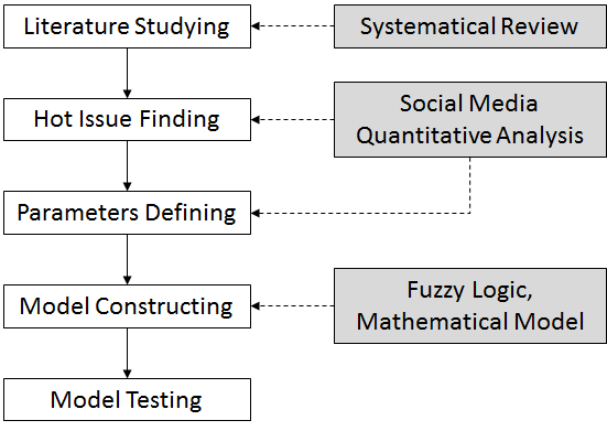

Fig. 1.Stage of Study

Furthermore, social media (in this case is Twitter) users' behavior discussing one topic is analyzed to find hot current topic (in the second stage). Here, free social media analyzer (i.e. talkwalter.com) is operated to get insight topic. Seven days (from 22st of August until 28th of August 2019)), Twitter, "sampah", Indonesia, and Bahasa are terms used for mentioning day number, social media type, search keyword, county/region, and language used respectively.

Top theme "sampah" (or "waste" in English) has been the most popular topic talked about. It makes sense, as the keyword used for searching is such a word. Also, "waste" has been big issue. Thus, currently, the theme is probably a big business/challenge confronted by Indonesia.

For next step, parameter analysis is conducted. Still, social media analyzer used to define parameters by investigating the popular hashtag obtained. Here, top five issues are becoming parameters of more than a hundred parameters candidates; and parameters' coefficient are defined thru relatively calculating a number of sentiment for each selected parameters.

Defined parameters are functioned academically to create DSM (the third stage). It is probably able to be called as participative model, as all parameters defined coming from what Twitter users mentioned; then several academic literatures functioned to verify them. Also, to measure the current condition, public's participation is functioned via questioner/survey conduction. Here, fuzzy logic, mathematical model, and quantitative analysis operated to do so. Fuzzy logic used to eliminate bias value of parameters [12]. The mathematical concept functioned to describe the interconnection among parameters clearly and to define the decision function. And quantitative analysis used to elaborate all elements in the model.

Based on empiric data collected via online questioner for implementing public's participation, the constructed model is tested. The model finally is able to present the quality value of waste management and suggested decision actions to do.

IV. RESULT AND DISCUSSION

The issue of waste management is big concern discussed by Twitter's users currently. More than 58,600 mentions, from 22,508 female and 20,033 male users, are delivered via Twitter. A number of mentions for each days is delivered in Fig. 2. With types of users' occupation are depicted in Fig. 3.

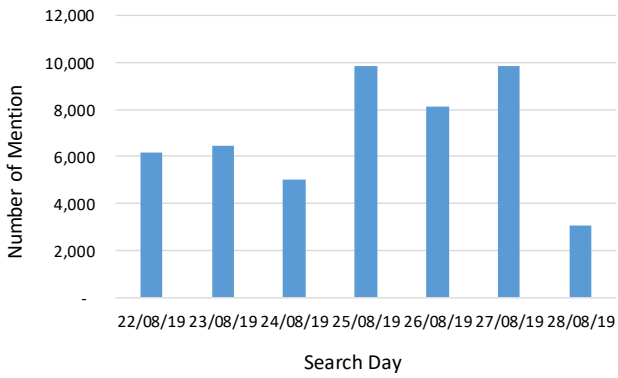

Fig. 2. Mention Number for Seven Days Searching

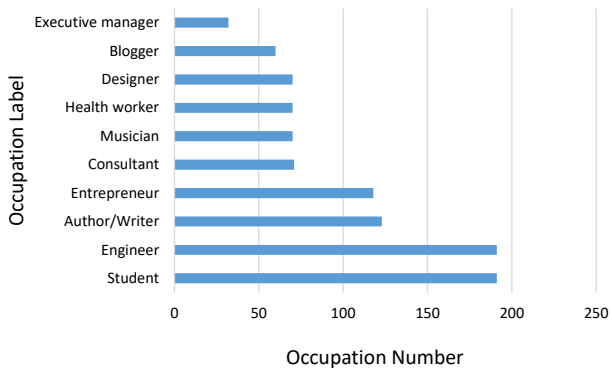

Fig. 3. Users' Occupation Types

For all mentions successfully collected, five parameters are defined. Table-I describes the parameters with their relative coefficient values, and also with references for verifying the parameters. Thus, the quality of waste management (WMQ) could be simply described via equation (1); where α is a quality of "environmental awareness", β represents a quality of "public's knowledge", γ signifies a performance of "regulation/law enforcement", δ implies a quality "opportunity", and ε indicates a performance "public facility".

Fundamentally, parameter "environmental awareness" is a parameter to describe the level of public's awareness of waste's negative impact to environment. With its coefficient value 0.6, it is potential as a dominant factor in measuring the quality of waste management in Indonesia.

Furthermore, parameter "public's knowledge" operated to describe the public's understanding of waste; such as negative impact, potency, economic value, and others.

Table-I: Model's Parameters and Their Coefficients

No.	Parameter	Reference	Coefficient
1.	Environmental awareness	[13]	0.60
2.	Public's knowledge	[14]	0.17
3.	Regulation/law enforcement	[15]	0.15
4.	Opportunity	[16]	0.06
5.	Public facility	[17]	0.02

$$WMQ = 0.60\alpha + 0.17\beta + 0.15\gamma + 0.06\delta + 0.02\varepsilon \quad (1)$$

In addition, parameter "regulation/law enforcement" is functioned to see the quality of regulation developed and law implemented to punish a person who disobey the regulations related to waste. This parameter also can be used to see the regulation/law of waste management completeness. Then, the parameters "opportunity" and "public facility" functioned to see 'has waste been benefited for economic value?' and 'has public facility to manage waste been good?' respectively.

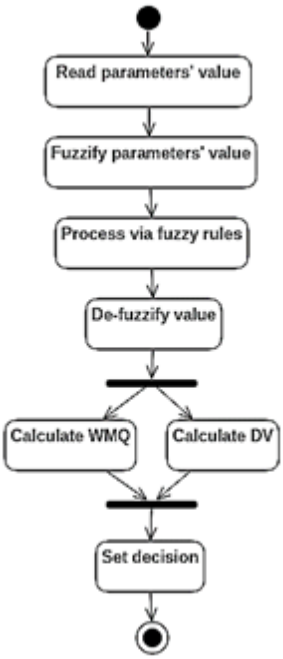

Fig. 4. The Proposed Model's Algorithm

The model's central algorithm made is illustrated in Fig. 4. It is containing seven steps. All parameters' value should be processed via fuzzy logic conception. There are three major activities here (i.e. fuzzify parameters' value, process via fuzzy rules, and de-fuzzify value). The de-fuzzified values are as inputs for calculating WMQ and decision value (DV). And finally, DV operated for setting the decision. Based on five parameters, with five areas of fuzzy value for each parameter (see membership function for each parameter in Fig. 5), 15 rules are operated to process their quality. The example of fuzzy rule for parameter "environmental awareness" (EA) to become α (with membership function configured in Fig. 6) is mentioned in Rule 1.

Rule 1. Fuzzy Rule for Parameter "Environmental Awareness"

```
IF (EA is VL) OR ((EA is L) THEN
    (α is B)
ELSE IF (EA is M) THEN
    (α is Mi)
ELSE (EA is H) OR (EA is VH)) THEN
    (α is G)
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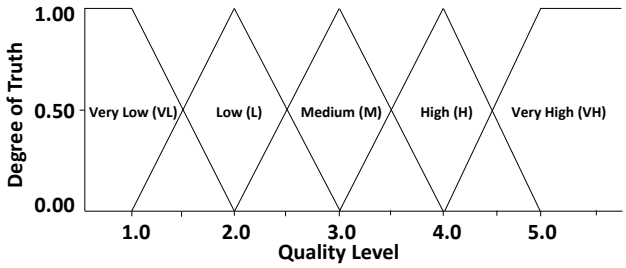

Fig. 5. Fuzzy Triangular Membership Function Operated for Each Parameter

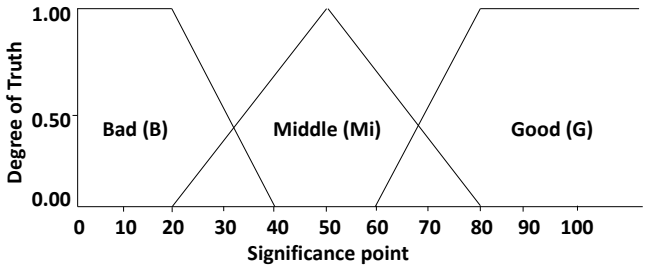

Fig. 6. Fuzzy Triangular Membership Function of Parameter Quality

Based on online questioner (as crisp input / CI), via membership function in Fig. 5, the measured quality (in fuzzy value) of each parameter represented in Table- II. Thru Rule 1, the fuzzy value of each parameter is converted to become quality (still in fuzzy value). It is presented in Table- III.

Furthermore, to obtain the decision value, one rule should be passed. It is decision value totally depends on each parameter. For example, the decision value based on α could be processed via Rule 2; where IM for improved and MA for maintained. The result of converting all quality values in Table- III via using Rule 2 and membership function in Fig. 6 indicates the highest priority should be rapidly improved.

Rule 2. Fuzzy Rule for EAQ to Produce Decision

```
IF (α is B) OR (α is Mi) THEN
  (DV is IM)
ELSE
  (DV is MA)
```

Table-II: Decision Act for Answering the Problem

Parameter	CI	Fuzzy Value
1.	3.78	0.22 M
		0.78 H
2.	4.78	0.22 H
		0.78 VH
3.	1.00	1.00 VL
4.	2.04	0.96 L
		0.04 M
5.	2.96	0.04 L
		0.96 M

Table-III: Quality for each Parameter

No.	Quality	Fuzzy Value
1.	α	0.22 Mi
		0.78 G
2.	β	0.22 G
		0.78 G
3.	γ	1.00 B
4.	δ	0.96 B
		0.04 Mi
5.	ε	0.96 B
		0.04 Mi

Table- IV presents fuzzy decision value for each parameter. To measure defuzzified-decision-value (DV_{def}), equation (2) operated; where DV_i is the ith decision value, CE_i signifies the ith centroid, and n denotes a number of decision value (it has one or two decision value). Then, thru equation (1), the WMQ in Indonesia could be calculated, it is 56.90. It indicates that the waste management in Indonesia should be improved much.

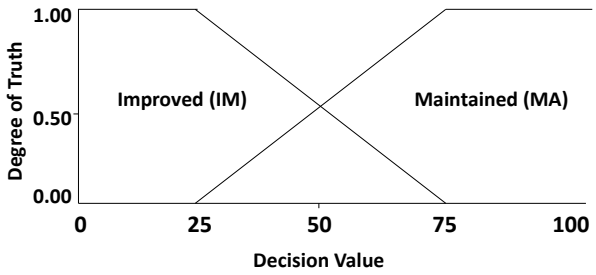

Fig. 6. Fuzzy Triangular Membership Function for Each Parameter

Furthermore, the relative DV_{def} (100 based value) is showed in Fig. 7. It presents objectively that three parameters (i.e. 'regulation/law enforcement", "opportunity", and "public facility") are parameters should be improved firstly. Two parameters categorized should be practically maintained are "public knowledge" and "environmental awareness".

Table-IV: Decision Value for each Parameter

Parameter	DV	DV_{def}
1.	0.22 IM	64
	0.78 MA	
2.	0.22 MA	75
	0.78 MA	
3.	1.00 IM	25
4.	0.94 IM	25
	0.04 IM	
5.	0.94 IM	25
	0.04 IM	

$$DV_{def} = \frac{\sum_{i=1}^{n}(DV_i \times CE_i)}{\sum_{i=1}^{n} DV_i} \qquad (2)$$

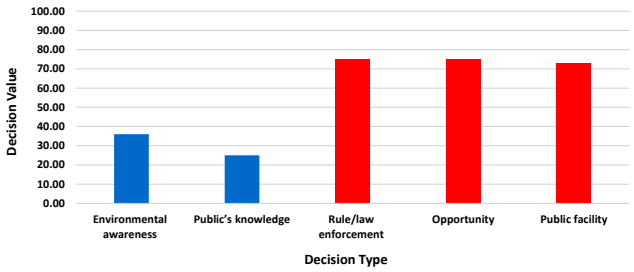

Fig. 7. Decision Value for Each Parameter

The group of decision type should be done by central or local government to answer the quality of waste management (problem) is presented in Table-V (the rows with gray area are decision acts should be done rapidly). The decision is strongly depending on DV suggested by model. IM is a value that must be taken by central/local government.

Table-V: Decision Act for Answering the Problem

Parameter	Decision
1.	Campaign, community movement, punishment/reward, developing waste treatment technology
2.	Campaign, school curriculum
3.	Making specific regulation, law players' quality improvement, campaign
4.	Cooperating among related institutions, making marketing division
5.	Developing waste management technology

V. CONCLUSION AND FURTHER WORKS

Clearly, issues grow in social-media possibly could be adopted to make a DSM. Here, DSM was constructed based on Twitter users' behavior. Issue regarding waste could be drilled-down step-by-step to become a DSM. It is able to calculate a quality of waste management in Indonesia. It is 56.90. It means, the quality of waste management in Indonesia should be upgraded extremely. Also, the model simulation showed that several decision related to aspects "regulation/law enforcement", "opportunity", and "public facility" should be solved as soon as possible via using several decision acts that have been defined. The specific decision should be taken is a chance to do in next study. Firstly define the decision alternatives in each parameter, determines interconnected parameters, and then construct the model. Moreover, broader data taken from social media (with several social media sources) are going to enrich the model developed.

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