E-commerce and woman entrepreneurs: A data mining of e-commerce statistics in Indonesia

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***Abstract*—The rapid ICT development in developing countries has offered people an opportunity to participate in e-commerce. This study departed from an exploratory question in the data mining context: "What information can be revealed regarding women entrepreneurs in e-commerce?" This study adopted a data mining approach, implemented through the Cross-Industry Standard Process for Data Mining framework, using Knime Analytics Platform as a data analysis tool. The context of data analysis is in Indonesia, and the unit of analysis is a province in which the e-commerce related data were aggregated per province. The result revealed that women e-commerce entrepreneurs were likely to have higher educational backgrounds and were younger than men entrepreneurs. In provinces where the percentage of e-commerce firms is low, women entrepreneurs contributed more than men. The finding provided evidence of the role of women e-commerce entrepreneurs in the country context. The policymakers and agents promoting woman empowerment might focus on facilitating women to enter e-commerce, especially in provinces with low e-commerce adoption.**

Keywords—e-commerce, entrepreneur, cluster analysis, data mining, Indonesia

I. INTRODUCTION

The rapid development of Information and Communication Technology (ICT) in developing countries has impacted society and business. Easy access to the internet and the affordable price of mobile phones make the majority of people familiar with using various mobile applications. In addition, the technological advancement of mobile phones and applications increases their friendliness to use. As a result, people use mobile applications to satisfy personal needs and do business, widely named electronic commerce (e-commerce).

One characteristic of developing countries is the existence of big informal employments, such as micro or small entrepreneur. The ICT development has offered an opportunity for people to enter e-commerce as a promising business solution in developing countries. The Indonesian statistics agency published the "E-commerce statistics" report indicated that the number of businesses entering e-commerce was about 2.3 million by 2020 [1]. The number represents 25% of all enterprises, primarily micro and small firms. They were joining e-commerce now become easy as several e-commerce platforms or marketplaces are growing. A marketplace could host and facilitate millions of small enterprises in e-commerce transactions. In Indonesia, the two marketplace start-ups named Tokopedia and Bukalapak became a unicorn (a term to name a start-up company with a valuation of more than 1 billion USD) in 2017 and 2018.

Study about women entrepreneurs in e-commerce has become a great topic. The study was aimed to identify characteristics and best practices for women entrepreneurs adopting e-commerce. In many countries, women were likely to give up their jobs when they started a family. The traditional belief toward women indicated that women's role is to take care of the family and manage home activities. Culture and low educational levels become inhibitors for the growing women entrepreneurs [2]. The rapid development of ICT and e-commerce applications can overcome the barriers.

Previous studies identified the vital role of e-commerce in empowering women. However, most studies were conducted through in-depth interviews or questionnaire surveys. Moreover, despite the many studies in that area, little research has been done using country-level data. Therefore, this study aims to address such a gap in the literature. This study emerged from an exploratory question in the data mining context: "What information can be revealed regarding women entrepreneurs in e-commerce? ". Several objectives were formulated: (1) to discover the age and education profiles of women e-commerce entrepreneurs; (2) to investigate whether e-commerce managed by women received higher revenue than those by men; and (3) to identify province's characteristics, where women e-commerce entrepreneurs contribute more. This study was conducted in the Indonesian context. The unit of analysis is a province in which the e-commerce related data were aggregated per province.

The following section presents the related work and, followed by section III, describes the research method and data. Furthermore, the results and discussions are presented in section IV, with the conclusion and policy implication in section V.

II. RELATED WORK

The definition of entrepreneur and e-commerce is widely convergent. The Cambridge Dictionary defines an entrepreneur as "someone who starts their own business, especially when this involves seeing a new opportunity" (dictionary.cambridge.org). The OECD defines e-commerce through the term e-commerce transaction as "the sale or purchase of goods or services, conducted over computer networks by methods specifically designed for the purpose of receiving or placing of orders" (stats.oecd.org). Thus, women

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e-commerce entrepreneurs are women who established their businesses and adopted e-commerce transactions.

E-commerce has been considered an effective solution for developing women entrepreneurship. The behavioral intention of women entrepreneurs to adopt e-commerce had been a study interest. Theory of Technology Acceptance Model (TAM) and The Unified Theory of Acceptance and Use of Technology (UTAUT) was often used. A study in the Indian context identified three constructs: performance expectancy, effort expectancy, and social influence, which significantly affected the intention of these women entrepreneurs to use e-commerce [3]. A study among women micro-entrepreneurs in South Africa confirmed that the decisions to use ICT were influenced by their perceptions of ICT ease of use and usefulness [4]. Based on the women's intention to adopt e-commerce, strategies to foster adoption could be formulated.

The barrier to promoting women's entrepreneurship in e-commerce was identified in some cultures. This cultural aspect comes from the traditional role of women in a family as a housewife. For example, a study among Emirati women identified six obstacles for doing e-commerce: employment, education, communication, privacy, compatibility, and funding [5]. Moreover, the lack of entrepreneurial skills was emphasized as a significant barrier for women establishing a start-up, in the Kingdom of Eswatini, in southern Africa [6]. By understanding the barriers, the government could execute facilitation programs.

Prior studies identified the success factors for women's entrepreneurship. The woman's social capital influenced competitive advantage, which leads to market performance [7]. For married women-entrepreneurs, the husband's support, such as planning and budgeting, was also critical for business success [8]. Comparison between men and women entrepreneurs indicated the difference in the business growth expectancy [9]. That study indicated that men entrepreneurs emphasized networking, while women entrepreneurs had prior experience. In e-commerce, limited studies investigated the comparison between women and men entrepreneurs.

Personal aspiration was the major encouragement for women entrepreneurs to set up a business [10]. A qualitative study investigating women e-commerce entrepreneurs in China revealed that e-commerce gives them financial impact and increases self-esteem and social status at home [11]. Similarly, women entrepreneurs in Bangladesh took the opportunity of social media such as Facebook to enter e-commerce and obtain financial benefits [12]. E-commerce also provided business opportunities for Chinese migrant women in Taiwan to set up international online transactions between mainland China and Taiwan [13]. India, a country with an enormous growth of e-commerce, has produced many prominent women entrepreneurs in e-commerce [14]. The increasing role of women in e-commerce has become a global phenomenon.

Prior studies about women e-commerce entrepreneurs were mainly based on surveys or interviews with a limited number of respondents or e-commerce firms. However, the official statistics published by the Indonesian government contain a large number of cases (e-commerce firms) with full country coverage. Therefore, the limited research in this area becomes the focus of the current study presented in this paper.

III. METHOD

A. Research method

This study belonged to secondary research and adopted the quantitative data analysis method. In addition, this study adopted and adapted the Cross-Industry Standard Process for Data Mining (CRISP-DM) framework [15]. It contained six phases of the data science life cycle: Business understanding, Data understanding, Data preparation, Modelling, Evaluation, and Deployment. The first phase, business understanding, was adapted into research, referring to the data mining objective. The objective was to find a pattern about women's entrepreneurship in e-commerce. At the same time, data analysis used a data mining approach which the Knime Analytics Platform implemented as a computational tool. Knime was selected because it indicated higher accuracy than other freely available data mining tools: WEKA, Rapid miner, Tanagra, and Orange [16]. Second, Knime is an open-source and code-free analytic tool that interdisciplinary researchers might quickly adopt.

B. Data understanding and preparation

Data were gathered from the "E-commerce Statistics 2021" report officially published by the Indonesian statistic agency [1]. The report presents various aspects of e-commerce published as an aggregate measure for 34 Indonesian provinces. The selection of relevant e-commerce measures was conducted using an exploratory approach, consistent with data mining.

After investigating the available measures, the four measures about gender, entrepreneur background, and e-commerce sales were selected, as follows:

- Percentage of male and female entrepreneurs in e-commerce (2 categories)
- Age distribution of e-commerce entrepreneurs (5 categories)
- Education background distribution of e-commerce entrepreneurs (4 categories)
- Total sales distribution of e-commerce (4 categories)

Each measure (variable) was transformed into two categories by considering the category values. For example, five categories of age (18-24, 25-34, 35-44, 45-54, >55 years) were collapsed into under 35 years and over 35 years old. The value of the four variables is a percentage. For example, the percentage of women entrepreneurs was 60%; it means 40% were man entrepreneurs. Table 1 presents the description of variables.

In addition, a measure of the e-commerce profile of each province was entered in data analysis. This measure is the percentage of e-commerce firms over total firms within a province, listed in Table 1 named size variable. The number of e-commerce firms of each province is displayed in descending order in Fig. 1. The plot shows that five provinces have a relatively considerable amount of e-commerce. It is reasonable as all five provinces are on Java Island, where 55% of Indonesia's population lives.

C. Modeling and Evaluation

A Knime workflow was created for data modeling and evaluation, shown in Fig. 2. The four related variables to entrepreneurs have no classification; therefore, the analysis

adopted the unsupervised learning method. In this method, clustering analysis was suitable for those four variables. Outlier data is an important issue to handle before applying cluster analysis. Knime provides the Numeric Outliers node to treat the outliers from the data. Five provinces were removed from further analysis because they have outliers in one or more variables. Therefore, 29 objects (provinces) proceeded to further analysis.

As the number of objects is not big, a simple cluster analysis k-means algorithm is appropriate. The number of clusters (k) should be determined in advance. The alternative cluster numbers were explored and evaluated through the Silhouette coefficient. It is a metric (value from -1 to 1) used to assess the goodness of a clustering technique. Table II displays the Silhouette coefficients of three alternatives of k, as 2, 3, and 4. The highest Silhouette mean score is for k=2. Hence, k-means clustering was determined with k=2.

Visualization of variables provides information regarding the collinearity between variables. For example, Fig. 3 displays the plot of four variables in ascending order of the percentage of women entrepreneurs in e-commerce. There is no collinearity; thus, cluster analysis is supported.

TABLE I. VARIABLE DESCRIPTION

Variable name	Measure description
female	Percentage of e-commerce with women entrepreneurs
age	Percentage of young e-commerce entrepreneurs (<35 years old)
college	Percentage of e-commerce entrepreneurs with tertiary education.
sales	Percentage of e-commerce with high total sales USD 21,000[a]
size	Percentage of e-commerce over total firms within a province

[a] USD 21,000 was converted from IDR 300 million

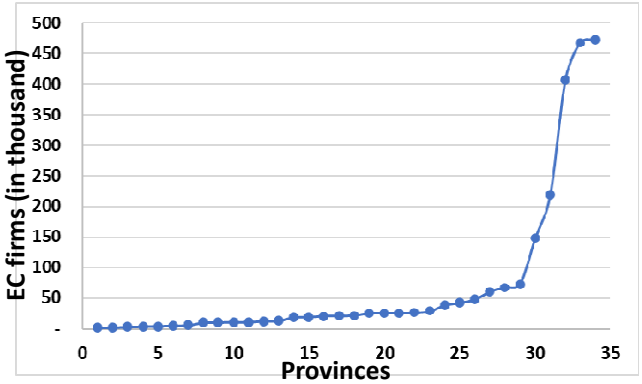

Fig. 1. The number of e-commerce among provinces.

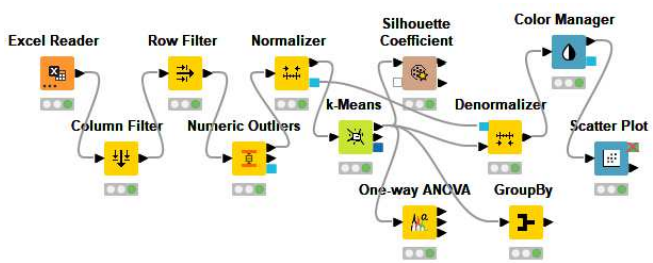

Fig. 2. Knime workflow.

TABLE II. MEAN OF SILHOUETTE COEFFICIENT

k	size	per cluster	overall
2	18; 11	0.293; 0.325	0.305
3	13; 12; 4	0.204; 0.275; 0.205	0.234
4	11; 6; 9; 3	0.228; 0.318; 0.149; 0.134	0.213

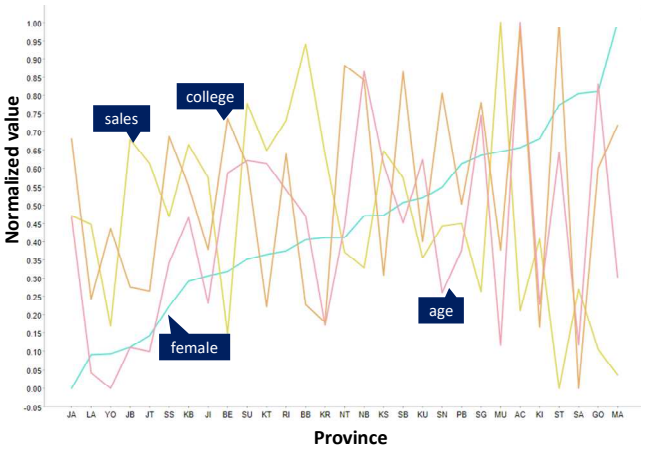

Fig. 3. A plot of four variables.

IV. RESULT AND DISCUSSION

A. Descriptive statistics

The descriptive statistics of the five variables are presented in Table III. It should be remembered that the unit of analysis is a province. The percentage of women entrepreneurs among provinces has a minimum of 39% (Jambi prov.) and a maximum of 80% (Maluku prov.). The mean value of 58% indicates that women entrepreneurs have a higher percentage than men among provinces. Furthermore, the percentage of young entrepreneurs (<35 years) who manage e-commerce was 38%. The percentage of e-commerce entrepreneurs attending college (from 1 year to doctorate program) was 29%. It means most entrepreneurs have formal education in high school or below. The sales variable indicates that e-commerce with revenue over USD 21,000 was only 13% on average. Finally, the size variable suggests that, on average, 24% of firms adopted e-commerce.

B. Clustering

Knime workflow was executed to group 29 provinces into Cluster A and B. Table IV presents 18 provinces in Cluster A and 11 provinces in Cluster B. The further issue is to verify which variables are significantly differentiated by two clusters. The ANOVA test was performed using the ANOVA node (Fig. 1) to examine whether the five variables differentiated two clusters. As shown in Table V, the result shows that all five variables significantly (p-values <0.05) determine both clusters.

The Groupby node of the Knime workflow was used (Fig. 1) to identify which cluster has a higher or lower mean value. The result is presented in Table VI. For example, cluster B could be identified as a group of provinces with more women e-commerce entrepreneurs than men. Conversely, cluster A is a group of provinces with higher

men e-commerce entrepreneurs than women. Furthermore, Cluster B was characterized as more younger entrepreneurs with a college education than entrepreneurs in cluster B. Finally, the level of e-commerce with a higher sales category and the percentage of firms adopting e-commerce is higher among provinces in Cluster A than Cluster B.

TABLE III. DESCRIPTIVE STATISTICS

Variable	Min (%)	Max (%)	Mean (%)	Std. deviation (%)
female	39	80	58	10
age	26	55	38	8
college	14	42	29	8
sales	6	21	13	4
size	13	35	24	6

TABLE IV. CLUSTER MEMBERS

Cluster A		
North Sumatra	Riau Islands	Central Kalimantan
Riau	West Java	South Kalimantan
Jambi	Central Java	East Kalimantan
South Sumatra	Yogyakarta	North Sulawesi
Lampung	East Java	North Maluku
Bangka Belitung Isl	West Kalimantan	West Papua
Cluster B		
Aceh	East Nusa Tenggara	Southeast Sulawesi
West Sumatra	North Kalimantan	Gorontalo
Bengkulu	Central Sulawesi	Maluku
West Nusa Tenggara	South Sulawesi	

TABLE V. TABLE TYPE STYLES

variable	F-score	p-value
female	9.18	0.005
age	12.61	0.001
college	31.54	0.000
sales	18.94	0.000
size	9.96	0.004

TABLE VI. TABLE TYPE STYLES

variable	cluster A (18 Prov.)	cluster B (11 Prov.)	Total (29 Prov.)
female	0.35	**0.60**	0.45
age	0.31	**0.61**	0.43
college	0.37	**0.78**	0.53
sales	**0.59**	0.26	0.46
size	**0.60**	0.30	0.49

C. Graphs

The following visualization through scatter plots were aimed to find the relationship between two variables by looking at the distributed cluster members (provinces). Fig. 4 presents Cluster A and B within the female vs. college variables. The x-axis indicates the percentage of women e-commerce entrepreneurs. At the same time, the y-axis is the percentage of e-commerce entrepreneurs, at least having a college educational background. E-commerce firms in provinces of cluster B were likely managed by women entrepreneurs and had more college education. Prior studies in Malaysia indicated that formal education was a significant factor affecting women's entrepreneurial ventures in e-commerce [17].

Furthermore, Fig. 5 shows that women entrepreneurs likely managed e-commerce firms in provinces of cluster B and had more younger age entrepreneurs (< 35 years) than those in Cluster A. Fig. 6 portrays that e-commerce firms in provinces of cluster B were likely managed by women entrepreneurs and had fewer e-commerce firms with high sales categories (over 21000 USD). Instead, provinces with e-commerce managed by men entrepreneurs were more likely to have higher sales.

Fig 7, as the last figure, indicates that provinces with a higher percentage of women e-commerce entrepreneurs were likely to be provinces with a lower level of EC adoption. It is an important finding as more women entrepreneurs contribute to such conditions. Women have become a pioneer in e-commerce adoption.

Overall, the findings revealed the critical role of women entrepreneurs in e-commerce. Young and more educated women entrepreneurs have been contributed to the development of e-commerce. This study supports a prior study investigating Indonesian women e-commerce entrepreneurs emphasizing e-commerce as a solution for home-based working, increasing market access, and improving business competitiveness [10]. Similar phenomena are likely taking place in some other developing countries. Furthermore, the findings support other studies confirming that e-business is a powerful tool in enhancing women's empowerment [18]. The success of women entrepreneurs in e-commerce was determined by possessing two capabilities: partnership development and digital marketing capability [19]. The current study provides global insight relating to the women entrepreneur in e-commerce.

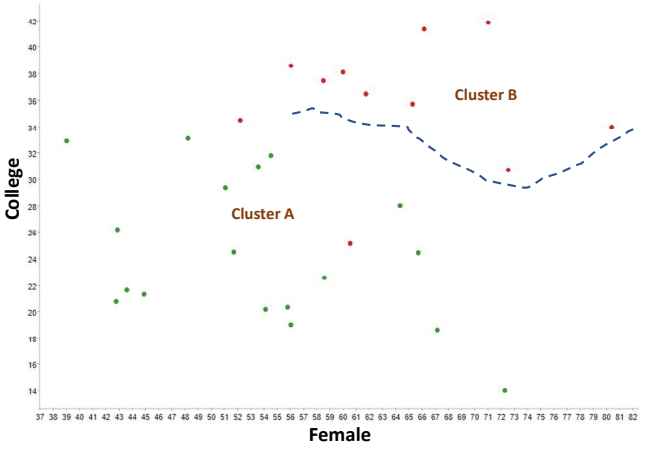

Fig. 4. Scatter plot of female vs. college variables.

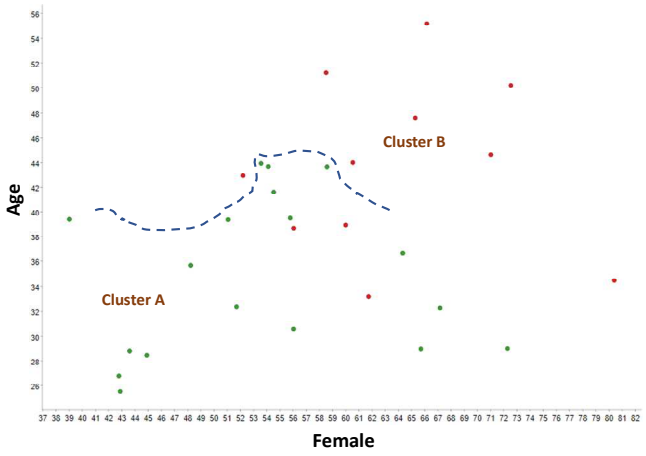

Fig. 5. Scatter plot of female vs. age variables.

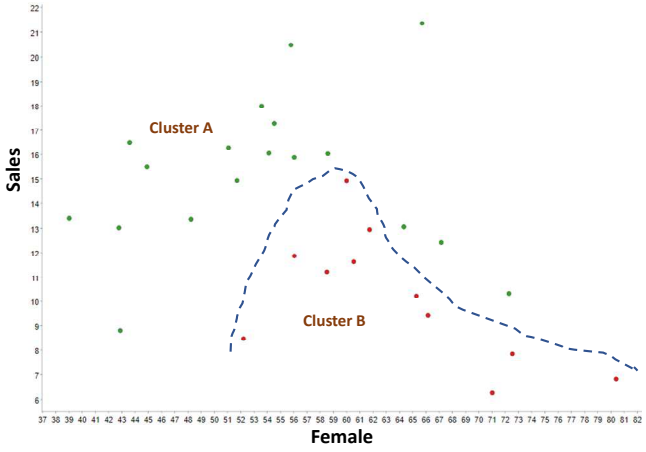

Fig. 6. Scatter plot of female vs. sales variables.

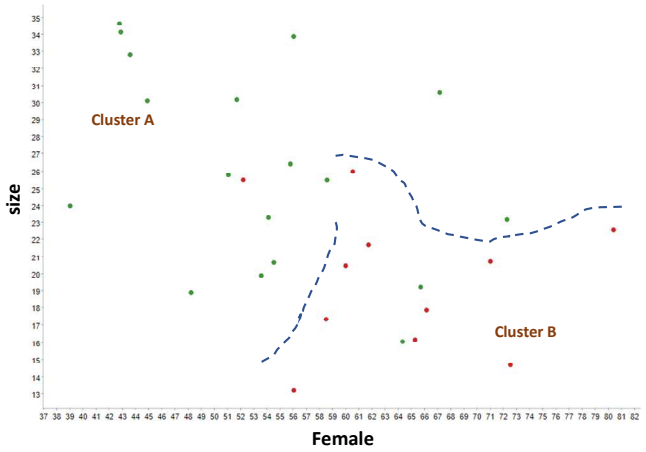

Fig. 7. Scatter plot of female vs. size variables.

V. Conclusion

Women entrepreneurship in e-commerce has been studied in many contexts and methods. The current study presents a contribution as methodologically using official statistics for country-level analysis. Women entrepreneurs were characterized as having a younger age category and more college education than men. However, more e-commerce with higher revenue categories was managed by men entrepreneurs than women. Women entrepreneurs played significant roles, especially in provinces where e-commerce adoption was low. The government promoting women's empowerment might facilitate women to enter e-commerce, especially in provinces where e-commerce adoption is low. The facilitation could be providing internet access, training for conducting business online, and business coaching. The government could cooperate with e-commerce platforms (marketplace) to provide facilitation, especially for women in rural areas. There is an opportunity to expand this research to other countries. In addition, the current study covered only five variables. Therefore, future work should examine other e-commerce variables such as operation and product category to capture a broader perspective.

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